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JAMES COOK UNIVERSITY

IMPACTS ON THE REGIONAL & STATE ECONOMIES
CONTRIBUTION TO HUMAN CAPITAL
IMPACTS OF RESEARCH

Prepared for James Cook University

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12024 JCU/Report

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Photo source: James Cook University

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INTRODUCTION

James Cook University (JCU) makes a significant contribution to the regional economy of Northern Queensland. The University also has a substantial impact on the state of Queensland, employing over 2,000 full time equivalent (FTE) staff and teaching over 12,000 FTE students. However, the economic impact of JCU is far greater than its annual expenditure in its operations, expenditure of staff and students. Its greatest contribution is to human capital which provides a very large and substantial boost to the economy and wellbeing of Queensland. JCU's research program can also demonstrate substantial impact on people living in the tropics, their health and well-being, economies and industries.

Above: the location of Cairns and Townsville Local Government Areas in Queensland. Source: ABS 2012

SCOPE OF THE STUDY

The Western Research Institute (WRI) was commissioned by JCU to undertake an assessment of the effects of the University in terms of:

- The economic impact of its operations in 2011 and 2012 on the economies of Cairns and Townsville Local Government Areas (LGAs) as well as on the economy of the state of Queensland;
- The generation of human capital through graduation of the University's students in 2011; and
- The impacts of JCU's research, as demonstrated through case studies.

BACKGROUND OF JCU

JCU has its origins as the University College of Townsville in 1960, and was proclaimed on 20 April 1970 as 'James Cook University of North Queensland' to be Australia's university for the tropics. In 1997, the University's name was changed to 'James Cook University', being a significant step in the institution's maturity and scope. JCU now has three tropical campuses located in Cairns, Singapore and Townsville, as well as study centres located in Mackay, Mount Isa and Thursday Island, the Russo Higher Education Group operated centre in Brisbane and course delivery through the Fiji National University School of Nursing. JCU is a key player in northern Queensland, on both a social and economic level. According to the Academic Ranking of World Universities, JCU is ranked in the top 4 percent of the world's tertiary institutions.[1]

The Townsville Campus, the largest of the University's campuses, is located in the suburb of Douglas. On-campus students are accommodated either on or off campus. The second largest campus is located in Cairns in the suburb of Smithfield. The Cairns Campus does not provide on-campus accommodation.

JCU offers both undergraduate and postgraduate courses under the following faculties:

- Arts, Education and Social Sciences;
- Law, Business and The Creative Arts;
- Medicine, Health and Molecular Sciences; and
- Science and Engineering.

1 www.jcu.edu.au – accessed 20 March 2013

IMPACTS ON THE REGIONAL AND STATE ECONOMIES: HIGHLIGHTS

The direct economic effects of JCU and the flow-on effects on upstream industries in Cairns and Townsville LGAs and the state of Queensland were measured in terms of full-time equivalent employment, household income and value added within each of the regions[2]. The impacts were based on the analysis of data for 2011 and 2012 regarding:

- James Cook University's operations – JCU provided WRI with detailed information about the University's operating expenditure and income, including staff wages, salaries and the number of FTE employees, along with the location of this expenditure and income.
- Capital expenditure – JCU provided information on capital expenditure for each LGA and elsewhere in QLD.
- Student expenditure – Derived expenditure by students from the Cairns and Townsville campuses.
- Graduation expenditure – Derived expenditure by non-local guests of graduates attending ceremonies at each campus.

2011 Economic Impact of JCU when flow-on effects are taken into account.

	Employment FTE	Household Income $m	Value added $m
Queensland	4,332	307.8	538.9
Cairns LGA	1,027	70.7	120.1
Townsville LGA	2,821	203.1	352.4

2012 Economic Impact of JCU when flow-on effects are taken into account.

	Employment FTE	Household Income $m	Value added $m
Queensland	4,862	350.2	587.1
Cairns LGA	1,148	80.6	137.5
Townsville LGA	3,138	228.9	398.0

It is estimated that JCU contributed $538.9 million to the Gross State Product of Queensland in 2011 and $587.1 million in 2012.

- It is estimated that JCU contributed $120.1 million to the Gross Regional Product of Cairns LGA in 2011 and $137.5 million in 2012.
- It is estimated that JCU contributed $352.4 million to the Gross Regional Product of Townsville LGA in 2011 and $398.0 million in 2012.

In light of the above, JCU plays a vital role in the contribution to Gross Regional Product in Cairns and Townsville and to Gross State Product in Queensland.

2 Refer to appendix 3: Glossary of terms for further explanation of this terminology

JAMES COOK UNIVERSITY

CONTRIBUTION TO HUMAN CAPITAL: HIGHLIGHTS

Beyond the impacts of a university's operations are its contributions to human capital: the knowledge, experience and other personal attributes that allow labour to be productive. Universities are crucial in developing human capital, especially in regional areas. The presence of graduates in a region demonstrably contributes higher wages and lower unemployment rates, and provides an educated workforce. Ultimately, this contribution to human capital is an important catalyst for growth, economic activity and wellbeing in regional areas.[3]

Lifetime contribution:

The lifetime contribution of JCU graduates (from 2011) has been calculated in terms of private value (employee captured) and public value (employer captured).

The total private value of the graduates that completed studies at JCU for 2011 alone is approximately $614.0 million over their working life. This consists of:

- $528.1 million in undergraduate completions over and above that realised for people without university qualifications; and
- $85.9 million in postgraduate completions over and above that realised for people with an undergraduate degree.

The public value of a University qualification is represented by the value the graduate generates for the respective employer. The total public value of JCU's graduates in 2011 over their working life was calculated to be approximately $546.9 million.

The total public and private value of graduates that completed studies at JCU in 2011 is approximately $1.16 billion over their working life.

Annual contribution:

WRI also estimated the annual private and public value of students graduating from JCU in 2011.

The total annual private value of JCU graduates in 2011 is approximately $37.3 million[4]. This consists of:

- $28.2 million in undergraduate completions over and above that realised for people without university qualifications; and
- $9.1 million in postgraduate completions over and above that realised for people with an undergraduate degree.

The estimated total annual public value of JCU graduates in 2011 is approximately $33.3 million.

The total annual private and public value of JCU graduates that completed studies in 2011 is $70.6 million.

JCU's contribution to the production of human capital has sustained impacts on the region. The ongoing graduation of students from JCU creates a pipeline of human capital supporting the region, its economic development and sustainability into the future.

3 In order to undertake this analysis it is assumed that: a JCU graduate is a person who completed studies at JCU in 2011; working life is 23 years to 65 years; inflation rate would be held constant at zero percent; the discount rate applied to the calculations of present value is 4.5 percent in line with James Cook University's current return on investments; and that JCU graduates in 2011 work in QLD for their entire working life.

4 Sum of the average incomes from the 2011 Census of the individual fields of education for James Cook University

IMPACTS OF RESEARCH: HIGHLIGHTS

JCU has a demonstrated commitment to 'research excellence and high impact' (JCU, University Plan 2013-17). Its location in the tropics is at the core of its research and engagement priorities which are centred on four highly relevant themes:

- Tropical Ecosystems and Environment;
- Industries and Economies in the Tropics;
- Peoples and Societies in the Tropics; and
- Tropical Health, Medicine and Biosecurity.

The examples of research impacts examined in this report demonstrate how deeply JCU's research has impacted upon people living in the tropics, their health and wellbeing, economies and industries. Moreover, the research undertaken at JCU has had demonstrable beneficial impacts at national and international levels.

This report examines the impacts of JCU's research in:

- Safely treating ear infection, NACCHO Ear Trial;
- Building safer low rise buildings, Cyclone Testing Station;
- The importance of backpackers to tourism in Australia, Tourism Research;
- Building capacity in Indigenous communities; Empowerment Research Program; and
- Towards a sustainable future for agriculture, Carbon Farming.

All of the case studies have impacted or are impacting tropical regions of Australia and often have impacts at national and international levels.

- One of the case studies is focussed on chronic middle ear infections in children in remote Aboriginal communities. It has had significant impacts on the approach to the treatment of ear infections and has lead to drug listings on the Pharmaceutical Benefits Scheme.
- Research into Backpacker Tourism has had substantial impacts on the backpacker tourism industry in tropical Australia, but has also impacted on the way Australia's national tourism policies and strategies have been enacted.
- The extensive body of work of the Cyclone Testing Station over 36 years demonstrates how researchers can partner with industry and government over the long term to effect change, and provide safer communities for those who live in the tropics.
- The well-being of Indigenous communities has been significantly improved through the Empowerment Research Program.
- A final case study looks at the prospective effects of biochar on farming in the tropics.

What these case studies reveal is that JCU can demonstrate substantial impacts from its research into people living in the tropics, their health and well-being, economies and industries. The impacts of research stand alongside the analyses of economic impact and human capital produced by the University, providing a snapshot of some of the significant contributions the University has made in its Australian and international tropical context.

JAMES COOK UNIVERSITY

JAMES COOK UNIVERSITY OVERALL IMPACT

The effects of a regional university such as James Cook University within its regions, nationally and internationally are wide and varied. This report quantifies JCU's economic impact and its contribution to human capital. The findings of these analyses demonstrate that the University makes a significant contribution to the regional economy of northern Queensland. At the economic level, by employing over 2,000 FTE staff and teaching over 12,000 FTE students the effects on the region are profound. However, the economic impact of JCU is far greater than its annual expenditure in its operations, expenditure of staff and students. Arguably its greatest contribution is to human capital which provides a very large and substantial boost to the economy and wellbeing of Queensland. Universities are crucial in developing human capital, especially in regional areas. The presence of graduates in a region demonstrably contributes higher wages and lower unemployment rates, and provides a more educated and productive workforce. Ultimately, this contribution to human capital is an important catalyst for growth, economic activity and wellbeing in regional areas.

The research impact case studies reveal another dimension of the effects a university has on its region. JCU's Tropical Strategy is perfectly aligned to its regional location. The research impact case studies demonstrate how a university can affect its region beyond the demonstrable economic and human capital impacts. Universities, with their inherent research capacity, investigate and provide evidence to improve health outcomes (Ear Trial and Empowerment Research Program), safety (Cyclone Testing Station), and economic development (Backpacker Tourism). JCU is the most critical piece of research infrastructure in northern Australia. Research at JCU contributes a substantial and very flexible capacity to address some of the most significant and challenging issues that confront the region. Through research impacts, its graduates, its own expenditure and the human capital it produces, JCU creates a pipeline of capital supporting the region, its economic development and sustainability into the future.

Photo source: James Cook University

IMPACTS ON THE REGIONAL AND STATE ECONOMIES

1.1 SUMMARY

The direct economic effects of JCU and the flow-on effects on upstream industries in Cairns and Townsville Local Government Areas and the state of Queensland were measured in terms of full-time equivalent (FTE) employment, household income and value added within each of the regions[5]. The impacts were based on the analysis of:

- James Cook University's operations – JCU provided WRI with detailed information about the University's operating expenditure and income, including staff wages, salaries and the number of FTE employees, along with the location of this expenditure and income.
- Capital expenditure – JCU provided information on capital expenditure for each LGA and elsewhere in QLD.
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5 Refer to appendix 3: Glossary of terms for further explanation of this terminology

1.2 METHODOLOGY

Input-output analysis was used in this study to determine the economic impact of JCU. Input-output analysis provides a detailed picture of the structure of a regional economy at a point in time, and can be used to estimate the contribution or impact of a particular sector of the economy including flow-on or multiplier effects.

An input-output table was developed for the state of Queensland for 2011-12. Regional input-output tables were then constructed for the LGAs of Cairns and Townsville for 2011-12. The economic impact of JCU has been estimated for the years 2011 and 2012.

Constructing the Tables

The input-output tables for this project were extracted from WRI's national input-output table for 2011-12 using the Generation of Regional Input-Output Tables (GRIT) technique. The national table was adjusted to represent Queensland and subsequently Cairns and Townsville using detailed data from:

- 2011 Census;
- 2011-12 National State Accounts for Queensland (ABS Cat No 5220.0);
- Australian Demographic Statistics (ABS Cat No 3101.0);
- Quarterly data on employment by industry sector (ABS cat. no. 6291.0.55.003); and
- Australian Industry data (ABS Cat No 8155.0).

The GRIT technique derives regional input-output tables from the national input-output table using location quotients and superior data (in this case, information regarding the operations of JCU as well as regional employment and income data) at various stages in the construction of the tables. The GRIT procedure was developed by Associate Professor Guy West and Professor Rod Jensen of the University of Queensland and is the most widely used method of constructing regional input-output tables in Australia. The GRIT method is also widely used in America and Europe.

Data Collection

JCU Operations

The national input-output table includes only one sector for all education and does not include a separate sector for university education. JCU provided WRI with detailed information of the University's expenditure, location of expenditure, employment and revenues. This information was used to construct a new sector row and column in the input-output table representing the operations of the University. This was then subtracted from the education sector.

The following assumptions were made regarding the income and expenditure resulting from the operations of JCU.

Income

JCU provided WRI with the income received by the University in 2011 and 2012. Income was allocated to the region from which it was paid. Higher Education Contribution Scheme (HECS) incomes, teaching fees and research grants were allocated to each campus according to the approximate distribution of Domestic and International Equivalent Full Time Student Load, staff numbers or a combination of staff numbers and student enrolment.

Wages and Salaries

JCU supplied information on the number of FTE employees and associated wages and salaries for the years 2011 and 2012. The number of FTE employees and associated remuneration was further disaggregated by residential address of the employees.

The impact of FTE employment and associated gross wages and salaries was allocated to the region of employment. However, in the case of Cairns, the economic impact was amended to account for staff residing in Kuranda, a locality approximately 30 mins drive from Cairns and outside the Cairns LGA. It was assumed that these staff would still spend a proportion of their income in the Cairns LGA (50 percent of Kuranda FTE employees and associated salaries have been applied in the model).

Other Expenditure

JCU supplied information regarding other expenditure during 2011 and 2012 by industry category and the location where the purchase was made. This was allocated to individual campuses. Local expenditure was defined as that made in the immediate local area. For example, only those purchases where the expenditure was made in Cairns LGA were classed as local for the Cairns LGA table. Imports were distributed according to the proportion each campus represented of total expenditure. Purchases from the state of Queensland were classified as local for the Queensland table, with the balance being treated as imports to the region.

Capital Expenditure

JCU provided information on capital expenditure for each LGA and elsewhere in QLD in 2011 and 2012. This was examined as a final demand impact and the results incorporated into the overall impact of each campus on its respective LGA.

Student Expenditure

JCU provided student enrolment data for Cairns and Townsville campuses for 2011 and 2012.

The following process was followed in order to model student expenditure:

1. JCU provided data regarding home address on enrolment and residential address during semester for all students studying on campus. It was noted, however, that students residing in Cairns, for example, can be undertaking a course at the Townsville campus by distance. Therefore, the base student numbers to be used for the economic impact on Cairns LGA, for instance, included all the JCU students residing in the Cairns LGA. Similarly, the economic impact on Townsville LGA used, as a starting point, the number of all JCU students residing in the Townsville LGA.

2. Statistics from the Department of Industry, Innovation, Science, Research and Tertiary Education[6] for 2011, indicated that 61.66 percent of the total students studying at regional universities in Queensland were classified as internal students. In light of this, the assumption was made that if JCU did not exist, all current non-local students and 61.66 percent of local students would move away from the local area in order to attend university. JCU's predominance as a provider of university education in the local area also supports this assumption.

3. Information relating to student expenditure was derived from a number of sources including the 2009 –10 ABS Household Expenditure Survey (ABS Cat No. 6530.0). The latter was inflated by the Consumer Price Index (ABS Cat. 6401.0) for the relevant categories, using the Brisbane index as a surrogate for the study locations. Average weekly expenditure for the second gross household income quintile was used as a proxy for student expenditure. The total annual expenditure calculated was checked for reasonableness against the Federal Government's website for students intending to study in Australia.[7]

6 http://www.innovation.gov.au/HigherEducation/HigherEducationStatistics/StatisticsPublications/Pages/2011StudentFullYear.aspx- accessed 21 March 2013

7 http://studyinaustralia.gov.au – retrieved March 2013

4. It was assumed that those living in on-campus accommodation had no expenditure on household goods or utilities. In addition, accommodation rental payments by students living on-campus were excluded to avoid double-counting, as these payments are already included in JCU revenues. As a substantial proportion of the residential packages available at the Townsville Campus include a catering component, the expenditure on food and beverage for those living on-campus was also reduced, when compared with those living in off-campus accommodation.

5. Only students who lived overseas on enrolment were assumed to contribute to a net increase in expenditure on health insurance, as it is compulsory for overseas students to take up health insurance coverage for the duration of their stay.

6. The approach to analysing Cairns and Townsville student expenditure cannot be applied to the state of Queensland. For Cairns and Townsville, it is appropriate to assume that all current non-local students and a proportion of local students would move away from the local area to attend university if JCU did not exist, because there are limited other options locally. For Queensland as a whole, however, there are numerous university education options across the state and therefore, it has been assumed that a large proportion of students are likely to stay in Queensland to study. Therefore, in order to estimate the impact of student expenditure on Queensland it was more appropriate to add together the regional impacts than to model according to the single campus process described. If campus modelling had been applied, then the impact on Queensland would be negligible.

Expenditure associated with graduation ceremony visitation

JCU provided information regarding the number of students attending graduation ceremonies at each campus, along with an estimate of the average number of guests per graduate (3). It was assumed that the origin of these guests was distributed in the same proportion as the students attending the graduation. Based on advice from JCU, the proportion of non-local graduates for each LGA was estimated. If a guest was deemed to be non-local, it was assumed that the guest would have one overnight stay in the LGA. Tourist expenditure data by LGA obtained from the Department of Resources, Energy and Tourism[8] was then used to estimate the likely additional expenditure in the relevant LGA generated by non-local guests attending graduation ceremonies. This expenditure is likely to be under-estimated as it does not include expenditure made by parents attending orientation on commencement. In addition, no allowance has been made for additional expenditure associated with attendance at residential schools.

Impact Analysis

Industry Significance

Input-output tables are frequently used to provide estimates of the significance of a particular industry or organisation in terms of its contribution to the economy. This is done by examining the effects of the organisation shutting down and ceasing all economic activities. This method provides an estimate of the level of economic activity that can be attributed to that particular organisation, in this case JCU. The industry significance approach was used to model the operations of JCU.

Final Demand Impacts

The impact of student expenditure was estimated as a final demand impact. Specifically, student expenditure was allocated to the relevant sectors to determine the impacts of this expenditure including both initial and flow-on effects. A similar approach was used for expenditure by visitors attending graduation and for capital expenditure impacts.

Total Impacts

The economic impact of JCU, in total, was estimated by aggregating the industry significance of the University, the final demand impacts of student expenditure, the final demand impacts generated by family and friends from outside the local area attending graduation ceremonies and the final demand impacts of capital expenditure. The impact of JCU on the study

8 Tourism Research Australia (2011). Regional Tourism Profile 2010-2011. Retrieved from http://www.ret.gov.au/tourism/documents/tra/regional tourism profiles/2010-11/regional_tourism_profiles_2010-11_final.xls

locations was estimated in terms of:

- Value added, which is equal to gross output minus intermediate inputs. Value added is equivalent to the contribution to gross regional product (GRP- the local equivalent of gross domestic product). That is, value added is the difference between the costs of production (excluding the compensation of employees, gross operating surplus, taxes and imports) and the value of sales turnover.
- Household income, which measures the benefit received by regional households from economic activity. It typically refers to compensation of employees but can also include income in return for productive activity such as the gross mixed income of unincorporated enterprises, gross operating surplus on dwellings owned by persons, and property income receivable and transfers receivable such as social assistance benefits and non-life insurance claims.
- Full-time equivalent employment is a measure of the workload of an employed person in a given location that makes workloads comparable across different types of employment (part-time, full time and casual). In this report, FTE employment is calculated as 1.0 x the number of full-time workers + 0.5 x the number of part-time workers.

The economic impact of JCU has been reported as a sum of:

- Initial impacts: defined as the value of the immediate changes in the regional economy of Cairns and Townsville as a result of increased expenditure of JCU; and
- Flow-on impacts: defined as the value of changes in the regional economy in the course of an additional round of spending after the initial expenditure of JCU was made.

Simulating Impacts on Regional Economies (SIRE) model

Economic impact analysis has been conducted using the 2011-12 Simulating Impacts on Regional Economies (SIRE) input-output model. The SIRE model is superior to standard input-output models, as it provides for non-linear relationships between variables and is based on empirically derived (rather than assumed) coefficients. In terms of robustness of results it is comparable with computable general equilibrium (CGE) models, whilst minimising data requirements. (See Appendix 1 for a description of the SIRE input-output model).

Assumptions

It should be noted that this assessment of the economic impact of JCU has been undertaken utilising conservative assumptions, including the following:

- No allowance has been made for additional economic impacts derived from visits to the region by family members, particularly those of overseas students. This would be expected to impact on the hospitality, transport and retail sectors in particular.
- No allowance has been made for expenditure by visiting academics which would also generate additional economic impacts.
- No allowance has been made for the present value of benefits derived from education provided to students by JCU. This includes the higher earnings of university graduates compared to non-graduates over their lifetimes and the economic benefits to society of having these graduates in the workforce. However, for estimates of the benefits of graduates from JCU in 2011, refer to section 2, Contribution to Human Capital.
- No allowance has been made for the present value of economic and other benefits from research and knowledge generation undertaken at JCU and from knowledge transfer through collaboration with industry and governments. However, for case studies examining the broad impacts of particular JCU research areas, refer to section 3, Impacts of Research, Case Studies.
- No allowance has been made for the contribution of the University to the social and cultural base of the regional community.

1.3 ECONOMIC IMPACT OF JAMES COOK UNIVERSITY

The economic impact of JCU was completed for 2011 and 2012 respectively. In preparing the report, data was provided to WRI from the University relating to income, expenditure, staffing, wages and salaries and student details for each of the following regions:

- Cairns LGA;
- Townsville LGA;
- Elsewhere in Queensland;
- Australian states other than Queensland; and
- Overseas.

Assumptions applied to this data are outlined in the methodology section of this report and allow WRI to provide a conservative estimation of the economic impact of JCU on Cairns, Townsville and Queensland.

Above: the location of Cairns and Townsville Local Government Areas in Queensland. Source: ABS 2012

The direct economic effects of JCU and the flow-on effects on upstream industries in Cairns and Townsville LGAs and the state of Queensland were measured in terms of:

- FTE employment - a measure of the workload of an employed person in a given location that makes workloads comparable across different types of employment (part-time, full-time and casual). In this report, FTE employment is calculated as 1.0 x the number of full-time workers + 0.5 x the number of part-time workers.
- Household income – which measures the benefit received by regional households from economic activity. It typically refers to compensation of employees but can also include income in return for productive activity such as the gross mixed income of unincorporated enterprises, gross operating surplus on dwellings owned by the person, and property income receivable and transfers receivable such as social assistance benefits and non-life insurance claims.
- Value-added – equal to gross output minus intermediate inputs. Value added is equivalent to the contribution to gross regional product (GRP - the local equivalent of gross domestic product). That is, value added is the difference between production (excluding the compensation of employees, gross operating surplus, taxes and imports) and the value of sales turnover.

The impacts were based on the analysis of:

- James Cook University's operations – JCU provided WRI with detailed information about the University's operating expenditure and income, including staff wages, salaries and the number of FTE employees, along with the location of this expenditure and income.
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ECONOMIC IMPACT IN 2011

Overall Impact on Queensland

This section examines the impact of JCU on the state of Queensland in 2011.

JCU Operations

The impact of the operations of JCU on Queensland is summarised in the table below.

	Employment FTE	Household Income $m	Value added $m
Initial	2,176	172.7	255.7
Flow-on	1,009	64.6	128.7
Total	3,185	237.3	384.4

Key features are as follows:

- Overall, the operations of JCU in 2011 contributed $384.4 million in gross state product, $237.3 million in household income and 3,185 FTE jobs to the Queensland economy which equates to 0.13 percent of gross state product, 0.17 percent of household income and 0.16 percent of FTE employment when flow-on effects are taken into account.
- The main industry sectors impacted by operations undertaken by JCU in terms of FTE employment were retail trade, hospitality services and health & community services.

Capital Expenditure

The economic impact of JCU's capital expenditure on Queensland is summarised in the table below.

	Employment FTE	Household Income $m	Value added $m
Initial	155	9.6	17.1
Flow-on	305	20.4	41.0
Total	460	30.0	58.1

Key features are as follows:

- Overall, capital expenditure undertaken by JCU in 2011 contributed $58.1 million in gross state product, $30.0 million in household income and 460 FTE jobs to the Queensland economy which equates to 0.02 percent of gross state product, 0.02 percent of household income and 0.02 percent of FTE employment when flow-on effects are taken into account.
- The main industry sectors impacted by capital expenditure undertaken by JCU in terms of FTE employment were construction, professional & scientific services and retail trade.

IMPACTS ON THE REGIONAL AND STATE ECONOMIES

Student Expenditure

The economic impact of student expenditure on Queensland by JCU students residing in Queensland is outlined in the table below.

	Employment FTE	Household Income $m	Value added $m
Initial	351	18.7	50.4
Flow-on	331	21.5	45.5
Total	682	40.2	95.9

Note: Data for students at the Russo Higher Education Group operated centre in Brisbane was not provided and therefore, their expenditures are not included.

Key features are as follows:

- Overall, expenditure by JCU students residing in Queensland contributed $95.9 million in gross state product, $40.2 million in household income and 682 FTE jobs to the Queensland economy in 2011 which equates to 0.03 percent of gross state product, 0.03 percent of household income and 0.03 percent of FTE employment when flow-on effects are taken into account.
- The main industry sectors impacted by expenditure by JCU students residing in Queensland in terms of FTE employment were retail trade, transport & storage and health & community services.

Total Impact

The total impact of JCU on Queensland was calculated by aggregating the impact of JCU operations, capital expenditure, expenditure of all JCU students residing in Queensland and the estimated expenditure generated by family and friends from outside Queensland attending graduation ceremonies. The impact of non-local graduation ceremony visitation was very low and therefore has not been presented separately but rather incorporated into the total impacts below.

The table below summarises the total impact of JCU on the economy of Queensland.

	Employment FTE	Household Income $m	Value added $m
Initial	2,685	201.1	323.4
Flow-on	1,647	106.7	215.5
Total	4,332	307.8	538.9

Note: the sum of data in the preceding tables may not equal the totals in this table due to rounding and the inclusion of graduation visitation impacts.

Key features are as follows:

- Overall, JCU contributed $538.9 million in gross state product, $307.8 million in household income and 4,332 FTE jobs to the Queensland economy in 2011 which equates to 0.18 percent of gross state product, 0.23 percent of household income and 0.22 percent of FTE employment when flow-on effects are taken into account.
- The main industry sectors in Queensland impacted by JCU in terms of FTE employment were retail trade, hospitality services and health & community services.

Impact on Cairns LGA

This section examines the impact of JCU's Cairns Campus on Cairns LGA in 2011.

JCU Operations

The impact of the operations of JCU on Cairns LGA is outlined in the table below.

	Employment FTE	Household Income $m	Value added $m
Initial	447	36.7	43.3
Flow-on	179	10.9	22.8
Total	626	47.6	66.1

Key features are as follows:

- Overall, the operations of JCU contributed $66.1 million in gross regional product, $47.6 million in household income and 626 FTE jobs to the Cairns economy which equates to 0.84 percent of gross regional product, 1.41 percent of household income and 1.18 percent of FTE employment when flow-on effects are taken into account.
- The main industry sectors impacted by JCU's operations in terms of FTE employment were the hospitality sector, retail trade and health and community services.

Capital Expenditure

The economic impact of the capital expenditure made by JCU on Cairns LGA is summarised in the table below.

	Employment FTE	Household Income $m	Value added $m
Initial	86	4.5	9.9
Flow-on	120	7.5	16.2
Total	206	12.0	26.1

Key features are as follows:

- Overall, capital expenditure undertaken by JCU contributed $26.1 million in gross regional product, $12.0 million in household income and 206 FTE jobs to the Cairns economy which equates to 0.33 percent of gross regional product, 0.35 percent of household income and 0.39 percent of FTE employment when flow-on effects are taken into account.
- The main industry sectors impacted by capital expenditure in terms of FTE employment were construction, other manufacturing and professional & scientific services.

IMPACTS ON THE REGIONAL AND STATE ECONOMIES

Student Expenditure

The economic impact of expenditure by JCU students residing in Cairns (during semester) on Cairns LGA is outlined in the table below.

	Employment FTE	Household Income $m	Value added $m
Initial	96	5.0	14.4
Flow-on	100	6.1	13.3
Total	196	11.1	27.7

Key features are as follows:

- Overall expenditure by JCU students residing in Cairns LGA contributed $27.7 million in gross regional product, $11.1 million in household income and 196 FTE jobs to the Cairns economy which equates to 0.35 percent of gross regional product, 0.33 percent of household income and 0.37 percent of FTE employment when flow-on effects are taken into account.
- The main industry sectors impacted by expenditure by JCU students residing in Cairns LGA in terms of FTE employment were retail trade, transport & storage and personal & other services.

Total Impact

The total impact of JCU on Cairns LGA was calculated by aggregating the impact of JCU operations, capital expenditure, expenditure of JCU students residing in Cairns and the estimated expenditure generated by family and friends from outside Cairns LGA attending graduation ceremonies. The impact of non-local graduation ceremony visitation was very low and therefore has not been presented separately but rather incorporated into the total impacts.

The table below summarises the total impact of JCU on the economy of Cairns LGA.

	Employment FTE	Household Income $m	Value added $m
Initial	629	46.2	67.7
Flow-on	398	24.5	52.4
Total	1,027	70.7	120.1

Note: the sum of data in the preceding tables may not equal the totals in this table due to rounding and the inclusion of graduation visitation impacts.

Key features are as follows:

- Overall, JCU contributed $120.1 million in gross regional product, $70.7 million in household income and 1,027 FTE jobs to the Cairns LGA economy which equates to 1.53 percent of gross regional product, 2.09 percent of household income and 1.94 percent of FTE employment when flow-on effects are taken into account.
- The main industry sectors in Cairns LGA impacted by JCU in terms of FTE employment were retail trade, hospitality services and construction.

Impact on Townsville LGA

This section examines the impact of JCU on the Townsville LGA in 2011.

JCU Operations

The impact of JCU's operations on Townsville LGA is outlined in the table below.

	Employment FTE	Household Income $m	Value added $m
Initial	1,588	126.5	186.9
Flow-on	583	36.6	75.7
Total	2,171	163.1	262.6

Key features are as follows:

- Overall, the operations of JCU contributed $262.6 million in gross regional product, $163.1 million in household income and 2,171 FTE jobs to the Townsville economy which equates to 2.92 percent of gross regional product, 3.99 percent of household income and 3.62 percent of FTE employment when flow-on effects are taken into account.
- The main industry sectors impacted by JCU's operations in terms of FTE employment were retail trade, hospitality services and education.

Capital Expenditure

The economic impact of the capital expenditure made by JCU on Townsville LGA is summarised in the table below.

	Employment FTE	Household Income $m	Value added $m
Initial	65	4.4	7.9
Flow-on	96	6.5	13.5
Total	161	10.9	21.4

Key features are as follows:

- Overall, capital expenditure undertaken by JCU contributed $21.4 million in gross regional product, $10.9 million in household income and 161 FTE jobs to the Townsville economy which equates to 0.24 percent of gross regional product, 0.27 percent of household income and 0.27 percent of FTE employment in Townsville LGA when flow-on effects are taken into account.
- The main industry sectors impacted by JCU's capital expenditure in terms of FTE employment were construction, professional & scientific services and machinery & equipment manufacturing.

IMPACTS ON THE REGIONAL AND STATE ECONOMIES

Student Expenditure

The economic impact of expenditure by JCU students residing in Townsville (during semester) on Townsville LGA is outlined in the table below.

	Employment FTE	Household Income $m	Value added $m
Initial	255	13.7	36.0
Flow-on	231	15.4	32.2
Total	486	29.1	68.2

Key features are as follows:

- Overall expenditure by JCU students residing in the Townsville LGA contributed $68.2 million in gross regional product, $29.1 million in household income and 486 FTE jobs to the Townsville economy which equates to 0.76 percent of gross regional product, 0.71 percent of household income and 0.81 percent of FTE employment when flow-on effects are taken into account.
- The main industry sectors impacted by expenditure by JCU students residing in Townsville LGA in terms of FTE employment were retail trade, transport & storage and health & community services.

Total Impact

The total impact of JCU on Townsville LGA was calculated by aggregating the impact of JCU operations, capital expenditure, expenditure of JCU students residing in Townsville and the estimated expenditure generated by family and friends from outside Townsville LGA attending graduation ceremonies. The impact of non-local graduation ceremony visitation was very low and therefore has not been presented separately but rather incorporated into the total impacts below.

The table below summarises the total impact of JCU on the economy of Townsville LGA.

	Employment FTE	Household Income $m	Value added $m
Initial	1,910	144.6	230.9
Flow-on	911	58.5	121.5
Total	2,821	203.1	352.4

Note: the sum of data in the preceding tables may not equal the totals in this table due to rounding and the inclusion of graduation visitation impacts.

Key features are as follows:

- Overall, JCU contributed $352.4 million in gross regional product, $203.1 million in household income and 2,821 FTE jobs to the Townsville economy which equates to 3.92 percent of gross regional product, 4.97 percent of household income and 4.71 percent of FTE employment when flow-on effects are taken into account.
- The main industry sectors in Townsville LGA impacted by JCU in terms of FTE employment were retail trade, health & community services and hospitality.

ECONOMIC IMPACT IN 2012

Overall Impact on Queensland

This section examines the impact of JCU on the state of Queensland in 2012.

JCU Operations

The impact of the operations of JCU on Queensland is summarised in the table below.

	Employment FTE	Household Income $m	Value added $m
Initial	2,375	194.6	263.1
Flow-on	1,166	74.5	147.6
Total	3,541	269.1	410.7

Key features are as follows:

- Overall, the operations of JCU contributed $410.7 million in gross state product, $269.1 million in household income and 3,541 FTE jobs to the Queensland economy in 2012 which equates to 0.14 percent of gross state product, 0.20 percent of household income and 0.18 percent of FTE employment when flow-on effects are taken into account.
- The main industry sectors impacted by operations undertaken by JCU in terms of FTE employment were retail trade, hospitality and health & community services.

Capital Expenditure

The economic impact of JCU's capital expenditure on Queensland is summarised in the table below.

	Employment FTE	Household Income $m	Value added $m
Initial	213	12.5	23.0
Flow-on	424	28.3	57.1
Total	637	40.8	80.1

Key features are as follows:

- Overall, capital expenditure undertaken by JCU in Queensland contributed $80.1 million in gross state product, $40.8 million in household income and 637 FTE jobs to the Queensland economy which equates to 0.03 percent of gross state product, 0.03 percent of household income and 0.03 percent of FTE employment when flow-on effects are taken into account.
- The main industry sectors impacted by capital expenditure undertaken by JCU in terms of FTE employment were construction, other manufacturing and professional & scientific services.

IMPACTS ON THE REGIONAL AND STATE ECONOMIES

Student Expenditure

The economic impact of expenditure on Queensland by JCU students residing in Queensland is outlined in the table below.

	Employment FTE	Household Income $m	Value added $m
Initial	349	18.7	50.4
Flow-on	330	21.4	45.3
Total	679	40.1	95.7

Note: Data for students at the Russo Higher Education Group operated centre in Brisbane was not provided and therefore, their expenditures are not included.

Key features are as follows:

- Overall, expenditure by JCU students residing in Queensland contributed $95.7 million in gross state product, $40.1 million in household income and 679 FTE jobs to the Queensland economy which equates to 0.03 percent of gross state product, 0.03 percent of household income and 0.03 percent of FTE employment when flow-on effects are taken into account.
- The main industry sectors impacted by expenditure by all JCU students residing in Queensland in terms of FTE employment were retail trade, transport & storage and health & community services.

Total Impact

The total impact of JCU on Queensland was calculated by aggregating the impact of JCU operations, capital expenditure, expenditure of JCU students residing in Queensland and the estimated expenditure generated by family and friends from outside Queensland attending graduation ceremonies. The impact of non-local graduation ceremony visitation was very low and therefore has not been presented separately but rather incorporated into the total impacts below.

The table below summarises the total impact of JCU on the economy of Queensland.

	Employment FTE	Household Income $m	Value added $m
Initial	2,939	225.8	336.7
Flow-on	1,923	124.4	250.4
Total	4,862	350.2	587.1

Note: the sum of data in the preceding tables may not equal the totals in this table due to rounding and the inclusion of graduation visitation impacts.

Key features are as follows:

- Overall, JCU contributed $587.1 million in gross state product, $350.2 million in household income and 4,862 FTE jobs to the Queensland economy in 2012 which equates to 0.20 percent of gross state product, 0.26 percent of household income and 0.24 percent of FTE employment when flow-on effects are taken into account.
- The main industry sectors in Queensland impacted by JCU in terms of FTE employment were retail trade, hospitality and health & community services.

Impact on Cairns LGA

This section examines the impact of JCU on Cairns LGA in 2012.

JCU Operations

The impact of JCU's operations on Cairns LGA is outlined in the table below.

	Employment FTE	Household Income $m	Value added $m
Initial	502	42.8	52.0
Flow-on	218	13.2	27.4
Total	720	56.0	79.4

Key features are as follows:

- Overall, the operations of JCU contributed $79.4 million in gross state product, $56.0 million in household income and 720 FTE jobs to the Cairns economy which equates to 1.01 percent of gross regional product, 1.65 percent of household income and 1.36 percent of FTE employment when flow-on effects are taken into account.
- The main industry sectors impacted by operations undertaken by JCU in terms of FTE employment were hospitality services, retail trade and education.

Capital Expenditure

The economic impact of the capital expenditure made by JCU on Cairns LGA is summarised in the table below.

	Employment FTE	Household Income $m	Value added $m
Initial	87	4.5	10.5
Flow-on	135	8.4	18.3
Total	222	12.9	28.8

Key features are as follows:

- Overall, capital expenditure undertaken by JCU contributed $28.8 million in gross regional product, $12.9 million in household income and 222 FTE jobs to the Cairns economy which equates to 0.37 percent of gross regional product, 0.38 percent of household income and 0.42 percent of FTE employment when flow-on effects are taken into account.
- The main industry sectors impacted by `capital expenditure undertaken by JCU in terms of FTE employment were construction, other manufacturing and professional & scientific services.

IMPACTS ON THE REGIONAL AND STATE ECONOMIES

Student Expenditure

The economic impact of expenditure on Cairns by JCU students residing in the Cairns LGA (during semester) is outlined in the table below.

	Employment FTE	Household Income $m	Value added $m
Initial	101	5.3	15.3
Flow-on	105	6.4	14.0
Total	206	11.7	29.3

Key features are as follows:

- Overall expenditure by JCU students residing in the Cairns LGA contributed $29.3 million in gross regional product, $11.7 million in household income and 206 FTE jobs to the Cairns economy which equates to 0.37 percent of gross regional product, 0.35 percent of household income and 0.39 percent of FTE employment when flow-on effects are taken into account.
- The main industry sectors impacted by expenditure by JCU students residing in Cairns LGA in terms of FTE employment were retail trade, transport & storage and personal & other services.

Total Impact

The total impact of JCU on Cairns LGA was calculated by aggregating the impact of JCU operations, capital expenditure, expenditure of JCU students residing in Cairns and the estimated expenditure generated by family and friends from outside Cairns LGA attending graduation ceremonies. The impact of non-local graduation ceremony visitation was very low and therefore has not been presented separately but rather incorporated into the total impacts below.

The table below summarises the total impact of JCU on the economy of Cairns LGA.

	Employment FTE	Household Income $m	Value added $m
Initial	690	52.6	77.8
Flow-on	458	28.0	59.7
Total	1,148	80.6	137.5

Note: the sum of data in the preceding tables may not equal the totals in this table due to rounding and the inclusion of graduation visitation impacts.

Key features are as follows:

- Overall, JCU contributed $137.5 million in gross regional product, $80.6 million in household income and 1,148 FTE jobs to the Cairns economy which equates to 1.75 percent of gross regional product, 2.38 percent of household income and 2.16 percent of FTE employment when flow-on effects are taken into account.
- The main industry sectors in Cairns LGA impacted by JCU in terms of FTE employment were retail trade, construction and hospitality services.

Impact on Townsville LGA

This section examines the impact of JCU on Townsville LGA in 2012.

JCU Operations

The impact of JCU's operations on Townsville LGA is outlined in the table below.

	Employment FTE	Household Income $m	Value added $m
Initial	1,728	141.2	211.3
Flow-on	667	41.6	85.5
Total	2,395	182.8	296.8

Key features are as follows:

- Overall, the operations of JCU contributed $296.8 million in gross regional product, $182.8 million in household income and 2,395 FTE jobs to the Townsville economy which equates to 3.30 percent of gross regional product, 4.47 percent of household income and 3.99 percent of FTE employment when flow-on effects are taken into account.
- The main industry sectors impacted by operations undertaken by JCU in terms of FTE employment were retail trade, education and hospitality services.

Capital Expenditure

The economic impact of the capital expenditure made by JCU on Townsville LGA is summarised in the table below.

	Employment FTE	Household Income $m	Value added $m
Initial	114	7.0	12.8
Flow-on	154	10.5	21.7
Total	268	17.5	34.5

Key features are as follows:

- Overall, capital expenditure undertaken by JCU contributed $34.5 million in gross regional product, $17.5 million in household income and 268 FTE jobs to the Townsville economy which equates to 0.38 percent of gross regional product, 0.43 percent of household income and 0.45 percent of FTE employment when flow-on effects are taken into account.
- The main industry sectors impacted by capital expenditure undertaken by JCU in terms of FTE employment were construction, other manufacturing and professional & scientific services.

IMPACTS ON THE REGIONAL AND STATE ECONOMIES

Student Expenditure

The economic impact of expenditure by JCU students residing in the Townsville LGA (during semester) is outlined in the table below.

	Employment FTE	Household Income $m	Value added $m
Initial	248	13.4	35.1
Flow-on	225	15.0	31.3
Total	473	28.4	66.4

Key features are as follows:

- Overall expenditure by JCU students residing in the Townsville LGA contributed $66.4 million in gross regional product, $28.4 million in household income and 473 FTE jobs to the Townsville economy which equates to 0.74 percent of gross regional product, 0.69 percent of household income and 0.79 percent of FTE employment when flow-on effects are taken into account.
- The main industry sectors impacted by expenditure by JCU students residing in Townsville LGA in terms of FTE employment were retail trade, transport & storage and health & community services.

Total Impact

The total impact of JCU on Townsville LGA was calculated by aggregating the impact of JCU operations, capital expenditure, expenditure of JCU students residing in Townsville and the estimated expenditure generated by family and friends from outside Townsville LGA attending graduation ceremonies. The impact of non-local graduation ceremony visitation was very low and therefore has not been presented separately but rather incorporated into the total impacts below.

The table below summarises the total impact of JCU on the economy of Townsville LGA.

	Employment FTE	Household Income $m	Value added $m
Initial	2,091	161.7	259.3
Flow-on	1,047	67.2	138.7
Total	3,138	228.9	398.0

Note: the sum of data in the preceding tables may not equal the totals in this table due to rounding and the inclusion of graduation visitation impacts.

Key features are as follows:

- Overall, JCU contributed $398.0 million in gross regional product, $228.8 million in household income and 3,138 FTE jobs to the Townsville economy which equates to 4.43 percent of gross regional product, 5.60 percent of household income and 5.24 percent of FTE employment when flow-on effects are taken into account.
- The main industry sectors in Townsville LGA impacted by JCU in terms of FTE employment were retail trade, health & community services and hospitality services.

JAMES COOK UNIVERSITY

CONCLUSION

James Cook University plays a central role in tertiary education in north Queensland. It is estimated that JCU contributed $538.9 million to the Gross State Product of Queensland in 2011 and $587.1 million in 2012 when flow-on effects are taken into account. The tables below summarise the economic impact of JCU on the local economy.

2011 Economic Impact of JCU when flow-on effects are taken into account.

	Employment FTE	Household Income $m	Value added $m
Queensland	4,332	307.8	538.9
Cairns LGA	1,027	70.7	120.1
Townsville LGA	2,821	203.1	352.4

2012 Economic Impact of JCU when flow-on effects are taken into account.

	Employment FTE	Household Income $m	Value added $m
Queensland	4,862	350.2	587.1
Cairns LGA	1,148	80.6	137.5
Townsville LGA	3,138	228.9	398.0

- It is estimated that JCU contributed $120.1 million to the Gross Regional Product of Cairns LGA in 2011 and $137.5 million in 2012.
- It is estimated that JCU contributed $352.4 million to the Gross Regional Product of Townsville LGA in 2011 and $398.0 million in 2012.

The key sectors impacted in terms of FTE employment

At the state level key sectors impacted included:

- Retail trade;
- Hospitality; and
- Health and Community Services.

At the Cairns LGA level key sectors impacted included:

- Retail trade;
- Hospitality; and
- Construction.

At the Townsville LGA level key sectors impacted included:

- Retail trade;
- Health and community services; and
- Hospitality.

In light of the above, JCU plays a vital role in the contribution to Gross Regional Product in Cairns and Townsville and to Gross State Product in Queensland.

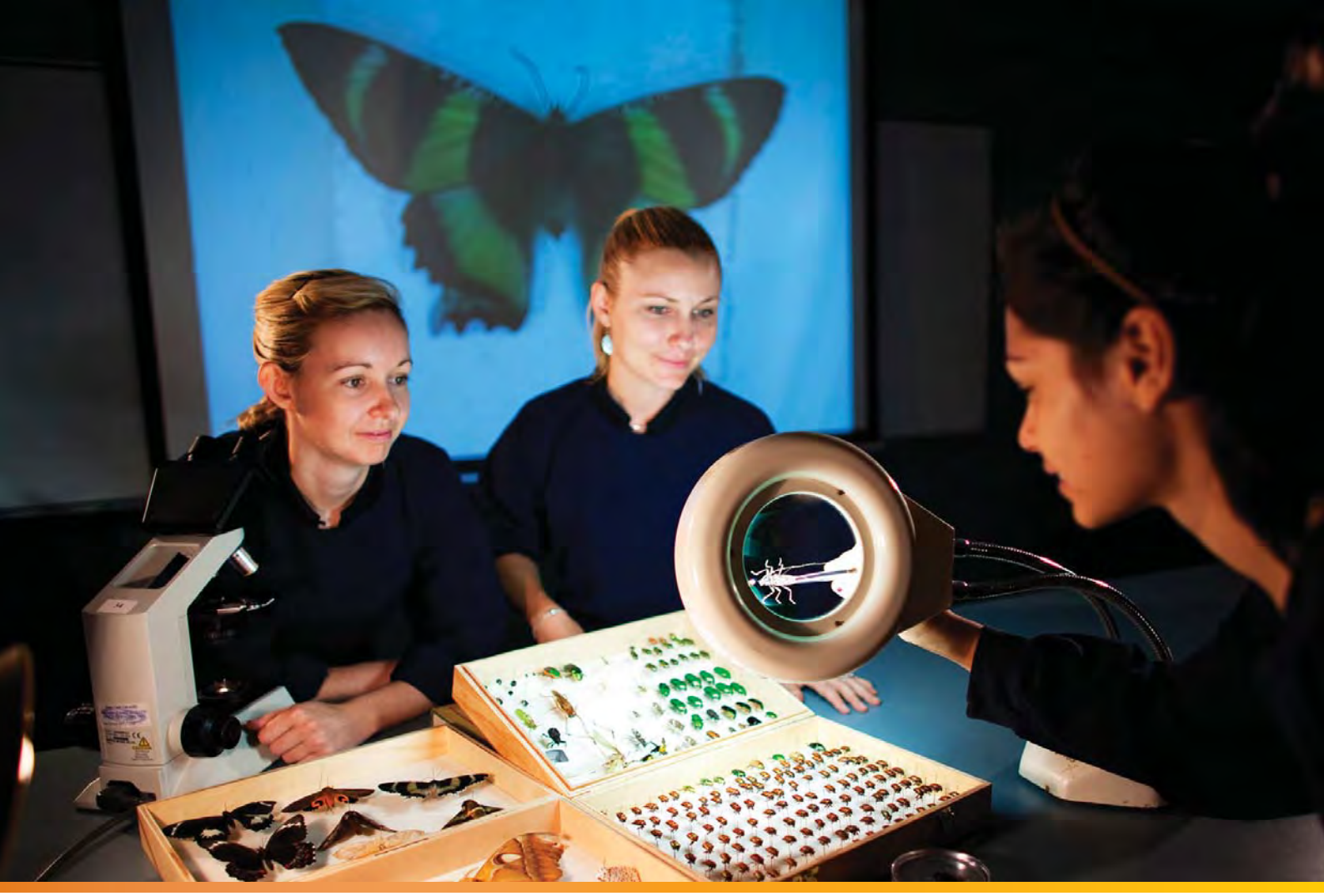

Photo source: James Cook University

CONTRIBUTION TO HUMAN CAPITAL

2.1 SUMMARY

Beyond the impacts of a university's operations are its contributions to human capital: the knowledge, experience and other personal attributes that allow labour to be productive. Universities are crucial in developing human capital, especially in regional areas. The presence of graduates in a region demonstrably contributes higher wages and lower unemployment rates, and provides an educated workforce. Ultimately, this contribution to human capital is an important catalyst for growth, economic activity and wellbeing in regional areas.

Lifetime contribution:

The lifetime contribution of JCU students who graduated in 2011 has been calculated in terms of private value (employee captured) and public value (employer captured).

The total private value of the graduates that completed studies at JCU in 2011 is approximately $614.0 million over their working life. This consists of:

- $528.1 million in undergraduate completions over and above that realised for people without university qualifications; and
- $85.9 million in postgraduate completions over and above that realised for people with an undergraduate degree.

The public value of a university qualification is represented by the value the graduate generates for the respective employer. The total public value of JCU's graduates from 2011 over their working life was calculated to be approximately $547 million.

The total public and private value of graduates that completed studies at JCU in 2011 is approximately $1.16 billion over their working life.

Annual contribution:

WRI also estimated the annual private and public value of students graduating from JCU in 2011. The values have been calculated based on 2011 Census data.

The total annual private value of JCU graduates from 2011 is approximately $37.3 million[9]. This consists of:

- $28.2 million in undergraduate completions over and above that realised for people without university qualifications; and
- $9.1 million in postgraduate completions over and above that realised for people with an undergraduate degree.

The estimated total annual public value of JCU graduates from 2011 is approximately $33.3 million.

The total annual private and public value of JCU graduates that completed studies in 2011 is $70.6 million.

9 Sum of the average incomes of the individual fields of education for James Cook University

2.2 METHODOLOGY

The major output of a university is converting non-degree holders to degree holders and undergraduate degree holders to postgraduate degree holders. Undergraduate degree holders, on average, earn higher wages than non-degree holders, and postgraduate degree holders, on average, earn higher wages than undergraduate degree holders. The wage premiums accruing to graduates reflect differences in productivity. This difference in productivity also results in increased profits for organisations employing graduates. The value of this extra productivity can be measured by assuming that the benefits are distributed between the employee (graduate) and the employer in the same ratio as wages (compensation of employment) to profit (gross operating surplus) in the economy at large.

Human capital is therefore comprised of two components:

- the private value of a graduate (employee captured); and
- the public value of a graduate (employer captured).

It should be noted that "public value" in this analysis does not include intangible non-economic benefits such as cultural, health and other community benefits.

Human capital is produced for the entire working life of a graduate. As such, WRI has derived this by calculating the present value of lifetime earnings for the graduate and lifetime profit for the employer. In addition, an estimate of an annualised figure has been calculated.

The following sections describe the approach to determining:

1. The overall contribution of JCU graduates over their lifetime; and
2. An annualised figure indicative of the productivity of a JCU graduate for one year.[10]

Lifetime Contribution

Private Value

When calculating a university's contribution to private human capital, it is important to take into account the productivity of graduates over their working life represented by wages earned, and more specifically, the present value of this income stream[11]. The calculation of the private value that JCU graduates generate assumes, for simplicity, that all graduates are employed in the state of Queensland. In order to calculate the present value of incomes, WRI undertook an analysis of personal income data by age, qualification and field of education for the state of Queensland, drawn from the 2011 Census of Population and Housing.

The cross-sectional data available at the Census was used to simulate a time series of average income levels across fields of education and levels of university qualification (undergraduate versus post-graduate) as well as for people without university qualifications. The average annual incomes were then converted to present values using a discount rate of 4.5 percent[12]. The results of the simulation were applied to the number of JCU graduate completions in 2011 for each field of education. This has been compared to the present value results that would have been realised if these graduates did not hold a university qualification.

10 JCU graduate is a person who completed studies at JCU in 2011
11 Working life is assumed to be the ages 23 years to 65 years
12 In order to undertake the simulation it was assumed that the inflation rate would be held constant at zero percent. The discount rate applied to the calculations of present value is 4.5 percent in line with James Cook University's current return on investments. The data for the first year was discounted, as the individual would receive the total income at the end of the year and not at the beginning.

The resulting present values reported are:

- The present value of an undergraduate degree per field of education over and above that realised for people without university qualifications; and
- The present value of a postgraduate degree per field of education over and above that realised for people with an undergraduate degree in the field of education.

Other approaches to measuring private human capital have compared income results for graduates with income results for those who have only completed Year 12 schooling. This approach does not account for skill, and therefore human capital development, through other types of training and education, and therefore overstates the benefits accruing from university education. The approach taken by WRI compares the average incomes of university graduates with those of people without university qualifications and therefore produces a more conservative measure of private human capital.

Public Value

University graduates also generate value for the organisations for which they work. If this wasn't the case, it is assumed that the university graduate would not be employed. The value generated for the organisation by the JCU graduate is referred to as public value.

The calculation of the public value that JCU graduates generate assumes, for simplicity, that all graduates are employed in the state of Queensland. By doing this, WRI has been able to derive the public value estimates based on the following features of the Queensland input-output table:

1. Value generated for organisations in the economy can be represented by the total gross operating surplus (GOS) in the Queensland 2011-2012 input-output table – the public value.

2. The input-output table also records total compensation of employees (COE) which represents the private value attributed to individuals.

3. There is a relationship between public, private and total values, whereby the total value represents the sum of the public and private values. This relationship can be used to calculate the ratio of private value to total value in Queensland.

As a proportion of the COE is earned by students graduating from JCU in 2011, the resulting ratio can be applied to the JCU context in order to estimate the public, private and total values of human capital generated by JCU.

Similarly to the private value of JCU education, the public value captures:

- The additional value produced by holders of a JCU postgraduate degree above what they would have produced if they had an undergraduate degree, and
- The additional value produced by holders of a JCU undergraduate degree above what they would have produced if they had no university degree.

The complete methodology of public value calculation is presented in Appendix 2.

Annualised Private and Public Value of JCU Graduates

In addition to the lifetime value of JCU graduates, WRI has also estimated the annual private and public value of students graduating from JCU in 2011. The annualised results are only indicative of the potential productivity of a JCU graduate. As with the lifetime value calculated, the results do not take into account the intangible, non-monetary benefits of a JCU qualification including cultural, health and other community benefits.

Annualised Private Value

WRI utilised the cross-sectional data from the 2011 Census to calculate an average annual income for the individual fields of education, as well as for people without university qualifications. The results were then applied to the number of JCU graduate completions in 2011 for each field of education.

The annualised private figures reported represent:

- The average annual value of an undergraduate degree over and above that realised for people without university qualifications.
- The average annual value of a postgraduate degree over and above that realised for people with an undergraduate degree in the field of education.

Annualised Public Value

WRI assumed that the ratio of private value to total value in Queensland remained constant for the calculation of the annualised public value of JCU degrees.

2.3 CONTRIBUTION TO HUMAN CAPITAL

Beyond the impacts of a university's operations are its contributions to human capital: the knowledge, experience and other personal attributes that allow labour to be productive. Universities are crucial in developing human capital, especially in regional areas. The presence of graduates in a region demonstrably contributes higher wages and lower unemployment rates, and more importantly, provides an educated workforce. Ultimately, this contribution to human capital is an important catalyst for growth in regional areas.

Whilst precise methods of measuring human capital are complex, evolving and widely debated, WRI contends that broad estimates of a university's contribution to human capital can be developed from an analysis of data relating to qualifications, age and income (in this case from the ABS Census conducted in 2011).

Human capital is comprised of two components, the private value and the public value. By examining both private and public value of JCU education, it becomes possible to incorporate in the analysis the productivity benefits captured by graduates themselves (private value), as well as productivity gains captured by respective employers (public value).

It should be noted that "public value" in this analysis does not include intangible non-economic benefits such as cultural, health and other community benefits.

CONTRIBUTION TO HUMAN CAPITAL OVER A LIFETIME OF WORK

Overall value of Human Capital over a lifetime of work

The overall total public and private value of graduates that completed studies at JCU in 2011 is $1.16 billion.

Private Value of Human Capital

WRI considered the present value (PV) of JCU degrees as private value attributed to university graduates, coming in the form of salaries that JCU graduates will receive following graduation.

Data for the human capital analysis was sourced from the 2011 Census of Population and Housing for employed persons aged 23 to 65 in the state of Queensland, along with the number of postgraduate and undergraduate completions within each field of education (FOE) at JCU in 2011.

The human capital analysis indicates that the total PV of the graduates that completed studies at JCU in 2011 is approximately $614.0 million over their working lives.[13] This consists of:

- $528.1 million in undergraduate completions over and above that realised for people without university qualifications; and
- $85.9 million in postgraduate completions over and above that realised for people with an undergraduate degree.

An analysis of undergraduate and postgraduate completions is presented overleaf.

13 Sum of the present values of the individual fields of education for James Cook University

Total Present Value of employed James Cook University Undergraduates by Field of Education (FOE)

Bachelor Degree	2011 completions	Present Value ($)	PV per completion ($)
Health	537	187,601,629	349,351
Society and Culture	392	94,027,422	239,866
Management and Commerce	254	73,711,346	290,202
Natural and Physical Sciences	237	65,296,011	275,511
Engineering and Related Technologies	75	40,390,213	538,536
Education	150	28,072,973	187,153
Information Technology	55	21,146,070	384,474
Architecture and Building	21	8,237,944	392,283
Creative Arts	116	7,470,464	64,401
Agriculture, Environmental and Related Studies	11	2,118,488	192,590

Note: Due to rounding, data may not sum to the totals presented in this report.

Key points are as follows:

- James Cook University undergraduates in Health have the highest total PV in Queensland of $187.6 million compared to the other fields of education. They are followed by undergraduates in Society and Culture at $94.0 million and Management and Commerce at $73.7 million.
- Undergraduates in Agriculture, Environmental and Related Studies recorded the lowest total PV of $2.1 million.
- Undergraduates of Engineering and Related Technologies recorded the highest PV per completion, followed by those in Architecture and Building and Information Technology.
- Undergraduates in Creative Arts recorded the lowest PV per completion of $64,401.

Total Present Value of employed James Cook University Postgraduates by FOE

Postgraduate Degree	2011 completions	Present Value ($)	PV per completion ($)
Health	297	$38,054,234	$128,129
Natural and Physical Sciences	182	$18,598,880	$102,192
Society and Culture	152	$16,231,764	$106,788
Education	106	$7,810,966	$73,688
Management and Commerce	131	$5,996,997	$45,779
Agriculture, Environmental and Related Studies	5	$703,884	$140,777
Creative Arts	3	$161,162	$ 53,721
Engineering and Related Technologies	5	$44,446	$8,889
Information Technology	20	-$1,705,964	-$85,298

Note: Due to rounding, data may not sum to the totals presented in this report.

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Key points are as follows:

- James Cook University postgraduates in Health have the highest PV in Queensland, compared to the other fields of education. James Cook University postgraduates in Health have a total PV of $38.1 million. They are followed by postgraduates in Natural and Physical Sciences totalling $18.6 million.
- Postgraduates within the field of Information Technology recorded a negative total PV of $1.7 million and a negative PV per completion.[14]
- Postgraduates of Agriculture, Environmental and Related Studies recorded the highest PV per completion, followed by those in Health.

Public Value of Human Capital

University graduates also generate value for the organisations for which they work. If this was not the case, it is assumed that the university graduate would not be employed. The value generated for the organisation by the JCU graduate is referred to as public value.

For the purpose of calculating the public value of JCU education, WRI assumed that:

- The PV of JCU degrees is the private value captured by graduates themselves; and
- The relevant ratios between public, private and total value in the Queensland economy are applicable to the context of JCU.

Based on these assumptions, WRI calculated the total public value of JCU's graduates in 2011 over their working life to be approximately $546.9 million.

14 This negative result reflects the ABS Census data for 2011. On average, Information Technology postgraduates in Queensland earn a lower income compared to their Undergraduate counterparts.

ANNUAL CONTRIBUTION TO HUMAN CAPITAL

In addition to the lifetime value of JCU graduates, WRI also provided the annual private and public value of JCU graduates. The annualised results are only indicative of the potential productivity of a JCU graduate and do not reflect the true value of a University qualification. Cross-sectional data from the 2011 Census was used to estimate the annualised private and public value of JCU graduates in 2011.

Annual Value of Human Capital

The annual private and public value of JCU graduates who completed studies in 2011 is $70.6 million.

Annual Private Value of Human Capital

The income that a student earns after graduating from university represents the private value of holding a university qualification. The total annual private value of JCU graduates in 2011 is approximately $37.3 million[15]. This consists of:

- $28.2 million in undergraduate completions over and above that realised for people without university qualifications; and
- $9.1 million in postgraduate completions over and above that realised for people with an undergraduate degree.

Annual Public Value of Human Capital

The public value of a University qualification is represented by the value the graduate generates for the respective employer. The estimated total annual public value of JCU graduates in 2011 is approximately $33.3 million.

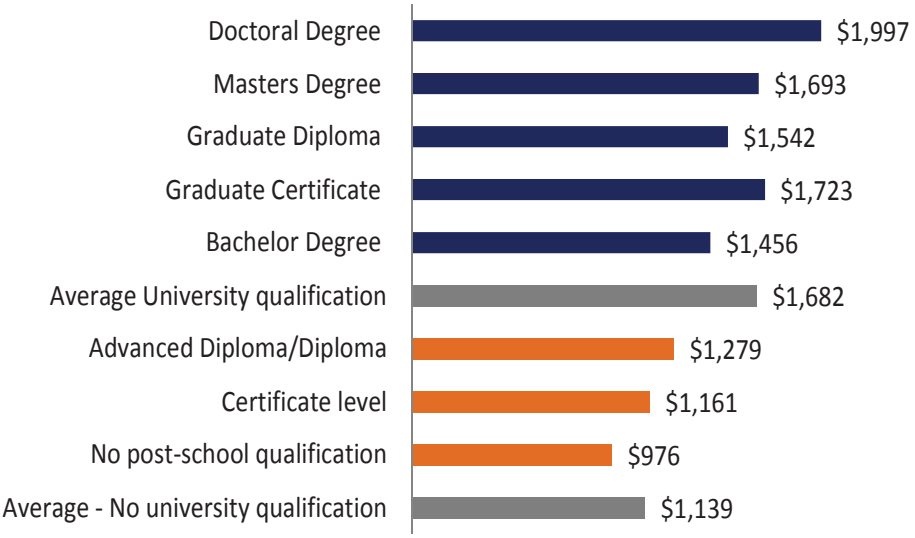
15 Sum of the average incomes of the individual fields of education for James Cook University

REGIONAL INCOME LEVELS

Cairns and Townsville LGAs

As at the 2011 Census, full time employed residents in the Local Government Areas of Cairns and Townsville, who hold a university qualification generally earn more income than those with an Advanced Diploma/Diploma, Certificate or no post-school qualification. The graph below clearly depicts the comparison between the average incomes of various university qualification levels with other or no post school qualifications.

Figure 1: Comparison of average gross weekly income for persons with university qualification in Cairns and Townsville LGAs to persons with other or no post-school qualification



Key points are as follows:

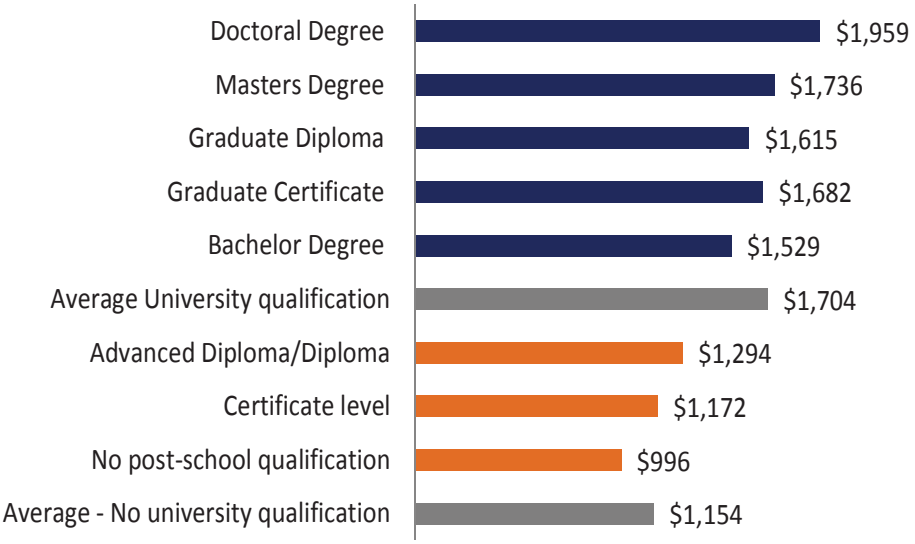
- On average, a person with a university qualification can earn $543 more in gross weekly income than those with no university qualification.
  - Those with a Bachelor degree can earn, on average, $317 more.
  - Those with a Graduate Certificate can earn, on average, $584 more.
  - Those with a Graduate Diploma can earn, on average, $403 more.
  - Those with a Masters degree can earn, on average, $554 more.
  - Those with a Doctoral degree can earn, on average, $858 more.

Graduate certificate holders, on average, earn higher incomes than those persons with a bachelor degree, graduate diploma or masters degree. Many graduate certificate holders are employed within the mining, manufacturing, transport and essential service sectors.

Queensland

Data from the 2011 Census was analysed for full time employed residents of Queensland who hold a university qualification. The analysis found that persons with a university qualification earn more than those with an Advanced Diploma/Diploma, Certificate or no post-school qualification in Queensland overall.

Figure 2: Comparison of average gross weekly income for persons with university qualification in Queensland to persons with other or no post-school qualification



Key points are as follows:

- On average, a person with a university qualification can earn $550 more in gross weekly income than those with no university qualification.
    - Those with a Bachelor degree can earn, on average, $375 more.
    - Those with a Graduate Certificate can earn, on average, $528 more.
    - Those with a Graduate Diploma can earn, on average, $461 more.
    - Those with a Masters degree can earn, on average, $582 more.
    - Those with a Doctoral degree can earn, on average, $805 more.

Unemployment Rate

On average, the unemployment rate for persons holding a university qualification is lower than for those with no post – school qualification. The table below shows a comparison between the unemployment rate for persons holding a university qualification compared to those who hold other qualifications or no post-school qualifications.

Unemployment Rate by post-school qualification, Cairns and Townsville LGA and Queensland, 2011

Post-school Qualification	Cairns and Townsville LGA	Queensland
Doctoral Degree Level	2.8%	2.1%
Master Degree Level	3.0%	4.1%
Graduate Diploma	2.3%	2.6%
Graduate Certificate	2.6%	2.7%
Bachelor Degree Level	2.7%	3.2%
Advanced Diploma	3.5%	3.7%
Diploma	4.0%	4.5%
Certificate III & IV Level	4.3%	4.8%
Certificate I & II Level	12.8%	13.6%
No post-school qualification	8.2%	8.3%
Total Region	5.9%	6.1%

Source: 2011 Census

Key points are as follows:

- Persons holding a university degree in the LGAs of Cairns and Townsville have a much lower level of unemployment compared to that for the region overall. The average unemployment rate for Cairns and Townsville LGAs was 5.9 percent in 2011 compared with an average of 2.7 percent for those holding a Bachelor Degree.
- Persons holding a Graduate Diploma have a lower average unemployment rate of 2.3 percent compared to all other university qualifications, other post school qualifications or no post school qualifications.
- Within Queensland, persons holding a Doctoral Degree have the lowest average rate of unemployment at 2.1 percent, compared to an average unemployment rate of 6.1 percent for Queensland overall.

CONCLUSION

The contribution to human capital by JCU is an important catalyst for growth in the region. The human capital analysis indicates that the total public and private value of graduates that completed studies at JCU in 2011 (over their working life) is approximately $1.16 billion. This comprises:

- approximately $614.0 million in total private or employee captured value; and
- approximately $546.9 million in total public value, representing the value the graduate generates for the respective employer.

The presence of graduates in a region demonstrably contributes higher wages and lower unemployment rates, and more importantly, provides an educated workforce. JCU provides regional educational opportunities to residents of north Queensland who would otherwise have limited access to those opportunities.

The ongoing graduation of students from JCU creates a pipeline of human capital supporting the region, its economic development and sustainability into the future.

IMPACTS OF RESEARCH CASE STUDIES

43

3.1 SUMMARY

JCU has a demonstrated commitment to 'research excellence and high impact' (JCU, University Plan 2013-17). This commitment is evident in the impacts that its research has had on tropical economies, health and the environment. JCU's strategy has the tropics at the core of its research and engagement priorities which are centred on four themes:

- Tropical Ecosystems and Environment,
- Industries and Economies in the Tropics,
- Peoples and Societies in the Tropics, and
- Tropical Health, Medicine and Biosecurity.

The examples of research impacts examined in this report demonstrate how deeply JCU's research has impacted on the environment, industries, economies and population, of Australia and internationally.

This report examines the research impacts of JCU's research through the following case studies:

- Safely treating ear infection, NACCHO Ear Trial
- Building safer low rise buildings, Cyclone Testing Station
- The importance of backpacker to tourism in Australia, Tourism research;
- Building capacity in Indigenous communities, Empowerment Research Program; and
- Towards a sustainable future in agriculture, Carbon Farming Trials.

All of the case studies have impacted or are impacting tropical regions of Australia and often have impacts at national and international levels.

- One of the case studies is focussed on chronic middle ear infections in children in remote Aboriginal communities. It has had significant impacts on the approach to the treatment of ear infections, with a direct impact through the treatment being incorporated into the Pharmaceutical Benefits Scheme.
- Research into backpacker tourism has had substantial impact on the backpacker tourist industry in tropical Australia, but has also impacted on the way Australia's national tourism policies and strategies have been enacted.
- The extensive body of work of the Cyclone Testing Station over 36 years demonstrates how researchers can partner with industry and government over the long term to effect change, and provide safer communities for those who live in the tropical regions of Australia.
- The well-being of Indigenous communities has been significantly improved through the Empowerment Research Program, contributing to resilience in some of Australia's most impoverished communities.
- The introduction of biochar to improve crop yields in tropical farming.

This report adopts the method of case studies to assess research impacts. The case study methodology builds upon and refines the approach used by previous analysis of research impact in studies such as the Group of Eight Australian Universities and the Australian Technology Network of Universities (Go8/ATN)[16]. The methodology is refined and improved in this report by seeking to quantify impacts when possible, seeking responses from those impacted by the research outcomes. In this approach we maintain that the impacts of the research can most ably be demonstrated, and in a cost effective manner. Central to WRI's case study methodology is the premise that university research is better assessed from the perspective of users and recipients of university research, rather than from the perspective of a university itself, panels of external observers, or imposed external indicators.

16 Group of Eight & Australian Technology Network of Universities. Excellence in Innovation. Research Impacting Our Nation's Future – Assessing the Benefits. November 2012.

In other words, when evaluating the impacts of JCU research, WRI focused on what actually happens with the research when it is applied "on the ground" and the impacts it had on practitioners. Emphasis was put on quantifiable impacts where possible.

What these case studies reveal is that JCU can demonstrate substantial impacts from its research into the people, economies and industries of Australia and internationally. The impact of research stands alongside the analyses of economic impact and human capital produced by the University. Combined, they provide a broad overview of the character and depth of effects the University has within its immediate and international tropical location.

3.2 METHODOLOGY

In this report, WRI uses case study methodology to evaluate the impact of university research.

In devising the case studies methodology, WRI ensured that it is well aligned with and builds upon national and international best practice, as well as academic literature on innovation. JCU also requested that WRI extend the case study method to examine one prospective study.

WRI methodology relied on principles that underpinned the UK's 2014 Research Excellence Framework (REF) and the 2011 Focusing Australia's Publicly Funded Research Review undertaken by the Department of Industry, Innovation, Science, Research and Tertiary Education (DIISRTE); respectively international and national methodological best practice reports:[17]

1. The predominant use of retrospective rather than prospective impacts, due to the uncertainty of the latter;
2. The demonstration of the link between the underpinning research and the claimed impacts;
3. The presentation of the nature and extent of the impact, specifically its benefits;
4. The verifiable approach to evidence in submissions (as opposed to verifying all evidence); and
5. The clear attribution of the claimed impact to the university at which the research was generated.

Central to WRI case study methodology is the premise that university research is better assessed from the perspective of users and recipients of university research, rather than from the perspective of the University itself, external observers, or imposed external indicators. In other words, when evaluating JCU research, WRI adopted a "bottom-up", rather than "top-down" perspective, and focused on what actually happens with the research when it is applied "on the ground".

The prospective study examines the emerging area of biochar and its application to farming. WRI modelled potential impacts and how the Tropical Research Strategy of JCU supports the growth of a new industry.

WRI continued the reliance on case studies as the most appropriate framework for research assessment, due to the fact that university research creates multiple innovations and changes across the whole socio-economic system and that citations and publications indicators do not appear to be appropriate instruments to measure impacts. However, in these case studies, wherever possible, greater emphasis was put on quantitative analysis. Furthermore, impacts on policy development or policy delivery "on the ground" are also evident.

When compared to the existing case study methodologies (e.g. those proposed by Go8/ATN), WRI case study analyses are a more straightforward means to evaluate research impacts, without compromising rigor.

- While existing case study analyses relied extensively on the opinion of academic experts and industry members to examine the impact of university research, they are one step removed from the actual research impact setting and may not readily understand the impact of university research on the actual community or on the wellbeing of this community (specifically, in the case of research that has social implications). In contrast, WRI methodology explicitly looks at a) How the research is put into practice and policy and b) How it affects and possibly benefits the community.

17 Department of Industry, Innovation, Science, Research and Tertiary Education. Focussing Australia's Publicly Funded Research Review – Maximising the Innovation Dividend. Review: Key Findings and Future Directions. DIISRTE, October 2011.

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- Existing case study methodologies acknowledge that in some cases the impact of university research may occur quickly, and in others it may take considerable time to be demonstrated. Hence, the universities participating in the assessment, were asked to submit information on research impacts over the preceding 5-year period. WRI develops this approach further, often over the longer term, looking at the stages of the research impacts – the initial impacts attributed to specific stakeholder(s), the secondary impacts manifested in policy and practice changes at various levels (local state and national), and broader and lasting impacts on communities and the economy.

- Most case study methodologies attempt to measure the impacts by allocating university research cases into specific sectors contained within Socio-economic Objectives (SEO) Classifications maintained by the ABS (e.g. defence, economic development, society and environment), and assigning a score index to each case study, based on the reach of the research (spread or breadth of influence) and its significance (intensity of the influence). WRI contends that the use of scores is an inferior and self-referential way of quantifying the reach and significance of university research, than the use of numerical data, due to the subjective judgement involved in the scoring process and likely quality, self-referential and verification problems. As a result, WRI aimed for quantification of impacts, where it was possible.

- Current methodologies are based on the implicit assumption that research in the university sector and transmission of research results to the rest of economy and society is akin to a bureaucratic process, where external research quality criteria potentially determine which research is beneficial and worthwhile and should (or should not) be pursued. Whereas in reality the value of university research is ultimately determined by users of research. WRI methodology in contrast makes the evaluation of research an interactive process, with relevant stakeholders and users involved in the evaluation process.

Note: please refer to appendix 5 for references cited in all of the following case studies.

SAFELY TREATING EAR INFECTIONS NACCHO EAR TRIAL

Introduction

It is well documented that positive health outcomes for the Aboriginal and Torres Strait Islander population are significantly lower than that of other Australians. Aboriginal and Torres Strait Islander health reform is a priority for the Council of Australian Governments, with many agencies engaged in a wide range of services in an attempt to bridge the gap. James Cook University (JCU) has made substantial contributions to research in this field. This case study demonstrates a community-centred approach to research that shows great potential for wider applicability to improve the delivery of services to the Indigenous Australian population, and other disadvantaged populations around the world.

A significant issue impacting upon Aboriginal peoples' health is the incidence of chronic middle ear infection (Chronic Suppurative Otitis Media [CSOM]). In Aboriginal children such is the extent of the disease that it is considered a "normal" part of their childhood, with rates of disease exceeding the World Health Organisation's (WHO) definition of a massive health problem.[i]

Statistics vary for rates of infection, but it is widely accepted that the prevalence of CSOM in Aboriginal communities significantly outweighs that in the general population of Australia. As an example of the extent of CSOM in these communities, in Western Australia in 2005, the rates of otitis media among Aboriginal children aged 5-9 months was found to be as high as 72 percent.[ii]

CSOM is a major cause of hearing loss among Aboriginal children, and although there is a lack of quantitative evidence to demonstrate links to educational outcomes, it is not difficult to make a connection between hearing problems and challenges of attending school, to learning itself, access to employment, quality of life and contribution to one's community.

Research undertaken by the National Aboriginal Community Controlled Health Organisation (NACCHO) between 2001 and 2002, in partnership with JCU and other organisations, sought to find a safer and more effective treatment for chronic middle ear infections using a new class of ototopical antibiotics (inserted in the ear) called 'the fluoroquinolones', which were proving effective in treating middle ear infections overseas in the US, Japan, and a number of European countries.

Prior to this research, the treatment of chronic middle ear infections relied on a topical antibiotic treatment which contained aminoglycosides, which have been shown to be potentially toxic to the middle ear in animal studies, causing deafness. Despite the drug's manufacturer not recommending its use for the treatment of CSOM (due to its toxicity to hearing) it is still prescribed for treatment of CSOM.

"Hearing is important. We worry about ears because hearing is so important to language, families, stories, learning, growing, being safe and being strong."

National Aboriginal Community Controlled Health Organisation (NACCHO)

Aboriginal Health Worker Ear and Health Care Training Manual, 2010[iii]

"Undertaking research involving remote Aboriginal communities can be complex. It was a significant attempt for a peak Aboriginal health body like NACCHO to embark on such a large-scale controlled clinical trial with a research institution such as James Cook University. For the research topic to be chosen by an Aboriginal organisation, and to be conducted and led by an Aboriginal organisation – that still remains unique within a clinical trial."

Associate Professor Sophia Couzos
Public Health Physician and General Practitioner, Discipline of General Practice and Rural Medicine, School of Medicine and Dentistry, JCU

This is due to concern that use of the alternative drug, ciprofloxacin, for ear infections may foster the development of resistance to this antibiotic, particularly in remote areas where CSOM is epidemic; however there is no evidence to support this view.

The NACCHO Ear Trial (the Trial) led by Associate Professor Sophia Couzos, who was a Public Health Officer with NACCHO at the time, assessed 111 children attending eight Aboriginal community controlled health services in remote communities in QLD and WA, by way of a randomised, double-blind controlled clinical trial – the first trial of its kind in Australia at the time.

The results of this research have had considerable impact on the way that chronic middle ear infection is approached in Australia.

Initial impacts of the research

Alternative and effective standard of treatment

The research trial successfully demonstrated that the alternative antibiotic ciprofloxacin was 47 percent more likely to cure CSOM in Aboriginal children than the existing contraindicated ototopical antibiotic.[iv]

The use of ciprofloxacin ear drops was found to shorten and cure the infection, however, the chronic nature of CSOM means that a child will most likely experience recurring infections.

Model of research

The research established a new standard of research involving the Australian Aboriginal population. The trial was community-centred and community-controlled and sought to build capacity within Aboriginal communities (for example by training Aboriginal Health Workers (AHWs) to administer the trial protocol) so that the intervention would be sustainable and transferable within those communities.

Applicability

With over 150 Aboriginal community-controlled health services (ACCHSs) across Australia, the potential exists for these services to engage in similar multi-centre research to realise solutions to health problems faced by Aboriginal peoples and Torres Strait Islanders, promoting productivity in healthcare delivery and achieving improved outcomes.[v]

"JCU was critical to the project getting funded and going ahead. That's the level of connection required to engage in a large scale, quality clinical trial. And the level of trust that NACCHO had in the relationship with JCU was critical to the Trial's success, too."

Associate Professor Sophia Couzos
Public Health Physician and General Practitioner, Discipline of General Practice and Rural Medicine, School of Medicine and Dentistry, JCU

National Awards given to the initial research paper[iv]

- 2003: Medical Journal of Australia/Wyeth Research Award-best research published in the MJA
- 2009: Ethnicity and Health (Journal) identified one paper from the six years 2003-2008 that was felt to be particularly important and ground breaking. "A thorough account of the characteristics of a community controlled research model to promote the engagement of Aboriginal communities in Australia in research targeted at addressing their health needs."[vi]

Impacts on Policy and Practices

Pharmaceutical Benefits Scheme (PBS)

The most significant impact of the NACCHO Ear Trial was that it led to ciprofloxacin ear drops being listed on the Pharmaceutical Benefits Scheme on 1st April 2007 for the management of CSOM. The research had direct impact on this treatment being incorporated as part of primary healthcare practices in Aboriginal communities. The listing on the PBS was recognised in national guidelines for the management of CSOM in Aboriginal and Torres Strait Islander populations with the inclusion of ciprofloxacin as the standard treatment for CSOM.[vii] The Australian Society of Otolaryngology, Head and Neck Surgery subsequently confirmed that the preferential treatment for CSOM should involve the use of non-toxic eardrops (such as ciprofloxacin).[viii]

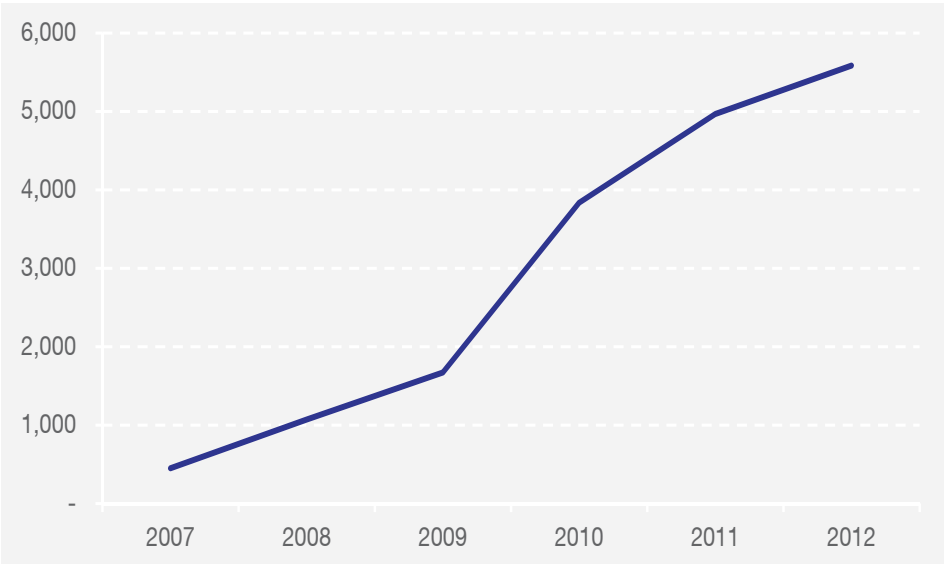
Topical ciprofloxacin was listed as the first line of treatment for CSOM in the Kimberley Aboriginal Medical Services Council Standing Orders.[ix]

As a result, Aboriginal Health Workers are now able to dispense the medication, according to the guidelines included in Standing Orders. Ciprofloxacin is also now included as second line treatment for CSOM in the Therapeutic Guidelines for Australia.

Listing ciprofloxacin on the PBS for the treatment of CSOM was critical to enable patient access to treatment at an affordable cost, given that those with CSOM are often those least able to afford the cost of medication. PBS listing meant that remote area Aboriginal health services could provide medication at no cost to the patient through the Section 100 provisions of the National Health Act (1953). With the subsequent introduction of the PBS Co-payment Measure under the National Partnership Agreement on Closing the Gap in Indigenous Health Outcomes, eligible patients across Australia can now access treatment for CSOM at no cost or substantially reduced co-payment.

The impact of the research can be quantified by the number of prescriptions that have been issued since inclusion on the PBS.

NUMBER OF PRESCRIPTIONS OF CIPROFLOXACIN EAR DROPS (PBS)



Source: Medicare Australia, 2013

17,129 prescriptions for ciprofloxacin ear drops were made through the PBS between January 2007 to December 2012.

(Note that ciprofloxacin is now PBS listed for treatment of CSOM affecting all Australians and the PBS statistics specifically for the Aboriginal and Torres Strait Islander population cannot be separated).

Impact of research on communities

As a result of ciprofloxacin being included on the PBS for the Aboriginal and Torres Strait Islander population, the authority listing for ciprofloxacin was extended on 1st November 2009 to the entire Australian population. This allowed ciprofloxacin to be prescribed to children who suffered from other middle ear infections, for example those caused by grommets.

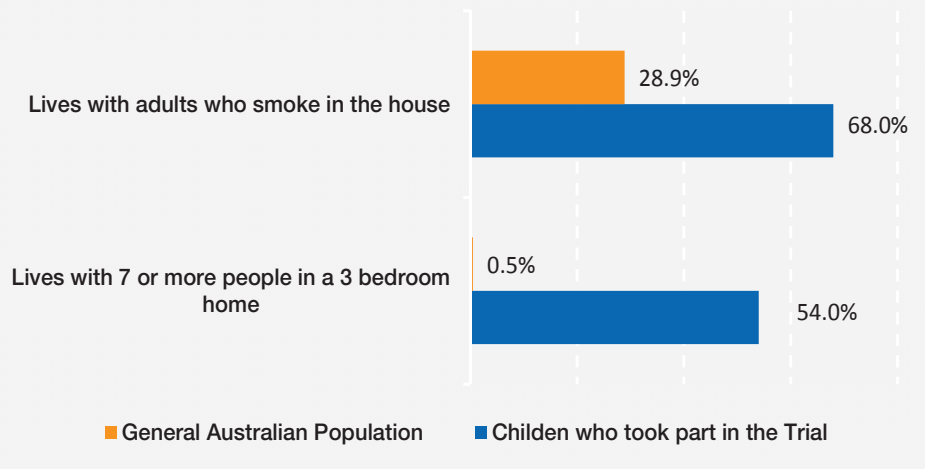
The research was also able to identify risk factors contributing to the incidence of CSOM in the children participating in the Trial, e.g. exposure to tobacco smoke and over-crowding in housing as shown in the graph below. This led to increased awareness amongst communities of the risk factors contributing to rates of infection.

It is difficult to demonstrate long term impacts of the research, unlike immunisation where a direct association between a disease and a cure can be clearly shown. The use of ciprofloxacin ototopical ear drops does shorten and cure CSOM, but only for that particular point in time. An Aboriginal child, due to social and environmental factors, will more than likely continue to suffer from middle ear infections throughout childhood - hence the 'chronic' characteristic of the disease.

However, the importance of providing General Practitioners and parents with a choice of an alternative, safer, more effective drug for the effective treatment of CSOM in Aboriginal or Torres Strait Islander children, cannot be overstated. In addition, the Trial was pivotal to the inclusion of ciprofloxacin on the PBS after many years of lobbying government and policy interventions; which has far-reaching effects to achieving improved outcomes for Indigenous Australian children's hearing.

Apart from these significant impacts, the research clearly shows potential for more profound impact into the future, in demonstrating the success that can be achieved when an Aboriginal community-controlled organisation, like NACCHO, partners with the expertise of a research leader such as James Cook University. The late Dr Puggy Hunter was a key driver of this research, saying in 2001 "Let's put our toe in the water... I think there is a major role in research looking at better ways of actually trying to solve this problem."[x] He was also visionary in seeing the potential of Aboriginal controlled research, adding 'We are not just participants in research, we are in charge.' The NACCHO Ear Trial is an excellent example to government and its agencies of strategic research, with applicability to successful delivery of other Indigenous-specific services, beyond healthcare.

RISK FACTORS OF CSOM



Source: Couzos et al [xi]

The impact of the research on communities is most evident in the comments from a remote area clinician with nearly 30 years experience pertaining to Aboriginal peoples' health.

"This seminal research has had an important effect on ear health. It has resulted in children with CSOM getting better more quickly and with less long term damage to their hearing."

Professor David Atkinson

Medical Educator, Kimberley Aboriginal Medical Services Council.

'In a partnership approach, NACCHO was keen to ensure that by treating ears, we might be able to improve educational outcomes and provide kids with the best possible start to their education. The trial was much talked about and really engaged with our member services. The process of undertaking resarch in our communities was strengthened through the learnings from this Trial and shows how good research coupled together with action and Aboriginal leadership can lead to good policy.'

Mr Justin Mohamed

Chairperson, NACCHO

"Had it not been for the awareness raising element of the Trial, many children would not have received ototopical antibiotics at all."

Couzos et al [xii]

BUILDING SAFER LOW RISE STRUCTURES CYCLONE TESTING STATION

Photo Source: Cyclone Testing Station

Introduction

Northern Australia is significantly impacted by regular cyclonic events. With the growth in population, economic activity and substantial infrastructure in northern Australia, it is increasingly critical to develop knowledge of how to build appropriate structures to ensure the safety and sustainability of Australia's population and economic growth.

Research undertaken by the Cyclone Testing Station (CTS) at James Cook University (JCU) has improved Australian and international knowledge of the effects of cyclonic events on low rise buildings, and informed industry on how to better construct infrastructure to withstand cyclonic winds.

Established in 1977 in response to the devastation caused by Cyclone Althea (Qld, 1971) and Cyclone Tracy in Darwin (NT, 1974), the CTS represents a sustained and valuable collaboration between researchers, industry, government and JCU to respond to these regular and destructive climatic events.

The CTS is Australia's only research and testing facility dedicated to understanding the impacts of cyclonic events, and determining the most effective methods of building cyclone-tolerant low-rise buildings. Other institutions undertaking wind research focus on high-rise buildings and bridges. The CTS is unique in that it investigates wind loads on residential housing and other low-rise structures. Employing sound research methods and state-of-the-art specialised equipment, the CTS has established its expertise on cyclone damage to a level that significantly contributes to national and international knowledge of how low-rise buildings can be constructed to better withstand the effects of cyclonic events.

As a result of developing test methods and promoting better building practices in the industry, the CTS significantly contributes to capacity building in the tropical region in preparation for, response to, and assessment of cyclonic events. It represents one of the most substantial and long term research impacts of James Cook University and its Tropical Research Strategy.

Impacts of the research

The impact and depth of work of the CTS has been and continues to be, considerable in improving the sustainability of built assets in the tropics. Its research has been continuous over 36 years and provides in-depth, extensive knowledge of buildings, materials and building techniques that informs both industry and government. The CTS has produced in excess of 59 publicly available Technical Reports to inform industry, government and communities, with many of the recommendations arising from those Reports being transferred into changes to the Australian Standards (AS) and the Building Code of Australia (BCA).

Transfer of knowledge through robust governance

The rapid and direct transfer to industry of research findings of the CTS is embedded in its corporate structure and operations, with an Advisory Board comprised of representatives from the building and insurance industries, state and local government, and James Cook University.

"There are very few places in the world that do what the CTS does. Although we have our own facility and the ability to undertake testing of building products ourselves, having an independent third party as a reference point and to offer expert advice, is invaluable."

Mr John Kralic
Manager Lysaght Technology,
BlueScope Steel

Building capacity through education and awareness

Research findings are translated through education and training programs for building manufacturers and construction industries, with CTS staff participating in roadshows to spread the message of the need to design structures to withstand cyclones. Visits to the wind testing tunnel located at the CTS by representatives of the building industry are a common and impactful way of demonstrating the power of wind on built structures via a cyclone simulation.

Just as importantly, the CTS contributes to local and state government publications, raising awareness and providing advice to communities on guidelines to be considered in the design and construction of homes and other low-rise buildings in cyclone events, and what to do in preparation for and response to cyclones.

CTS staff also spend time in the field undertaking assessments of structures, and are regularly invited to contribute to international conferences.

Building Codes and Australian Standards

The CTS is one of the few independent bodies that provides input into Australian Standards and the Building Code of Australia (BCA) on building performance. Its research and recommendations have had a substantial impact on the BCA for residential and other low-rise structures.

Thanks to its independence, CTS plays an important role in identifying issues that need improving if buildings are to offer acceptable performance in adverse weather. Having identified a problem, CTS works with other organisations to help in finding solutions. This may include assistance in the development of Australian Standards to set minimum acceptable standards of performance.

Where an industry solution is found to a problem or where the presence of an Australian Standard is sufficient to provide a solution, little further work is needed on that issue. If, however, the identified problem continues to exist, it may be necessary to propose a change to building regulations so that better practices become mandatory across the industry.

A recent example of this process occurred after CTS had identified a high failure rate of roller doors during Tropical Cyclone Yasi in 2011. This issue had also been identified in many previous events, so CTS worked with others from across the industry to develop a new Standard, AS/NZS 4505:2012 and put if forward for referencing in the BCA, which occurred in May 2013. As part of the process, it was shown that this upgrading would have a net benefit on building costs.

Photo Source: Cyclone Testing Station

CTS staff with a portable anemometer used to measure wind speeds.

"The work of the CTS has been central to our approach to preparation and also our response to cyclone events."

Mr Allen Morris
Manager, Emergency Management, Townsville City Council

"The CTS does a fantastic job on improving awareness in communities."

Mr John Kralic
Manager Lysaght Technology, BlueScope Steel

"The CTS is the 'honest broker' between the materials' manufacturers, the certifiers, the engineering consultants and the building industry in general; and through representation to Standards Australia, it is able to enforce changes to the Building Code."

Mr John Galloway
Chair, CTS Advisory Board and Construction Manager, Seymour Whyte

Influence on Building Practices

Prior to the formation of the CTS, building practices were clearly inadequate for low-rise buildings in cyclone regions. A contrast of damage sustained during Tropical Cyclones Althea (1971) and Tracy (1974) with Larry (2006) and Yasi (2011) provides a selective example of the CTS's body of research over three decades, and a contemporary context to understanding the extensive impact of that body of research.

SNAPSHOT OF RESEARCH IMPACT

1971 & 1974

Tropical Cyclone Althea (1971) and Tropical Cyclone Tracy (1974), cause extensive damage to built assets (e.g. 80 percent of homes destroyed in TC Tracy).

The Cyclone Testing Station is founded in response to damage caused by Tropical Cyclones Tracy and Althea.

1977

1982

"In a cyclone event, people are told to leave an engineered building (e.g. their workplace) and go home to take shelter – so those homes need to be up to that task."

Dr David Henderson
Director, Cyclone Testing Station.

The Home Building Code of Queensland (HBC) [4] was developed by many organisations including JCU and CTS, lobbying the government in response to the extensive damage to buildings caused by Tropical Cyclones Althea and Tracy.

The code was introduced in 1982, and CTS Report 51 states that:

"by 1984, it was reasonable to consider that houses in the cyclone region of Queensland were being fully designed and built to its requirements".[i]

Tropical Cyclone Larry makes landfall on 20th March 2006 near the town of Innisfail and causes damage to a number of buildings in Innisfail and the surrounding district.

The CTS was able to comprehensively demonstrate the effects to buildings that had been designed for cyclone conditions, and what happened to those that were not. In CTS Technical Report 51: Tropical Cyclone Larry, the CTS estimated that the extent of the damage was as follows:

In comparing contemporary housing (i.e. that built after 1985) with housing that was built before the Home Building Code (HBC) the contemporary housing sustained the lowest damage. The average damage to contemporary housing across the investigation area was less than 10 percent of its total value.[ii]

2006

"We can see from the work that CTS has done over the past two cyclone events that there is a marked improvement in the awareness of building and construction practices."

Mr John Kralic
Manager Lysaght Technology,
BlueScope Steel

2011

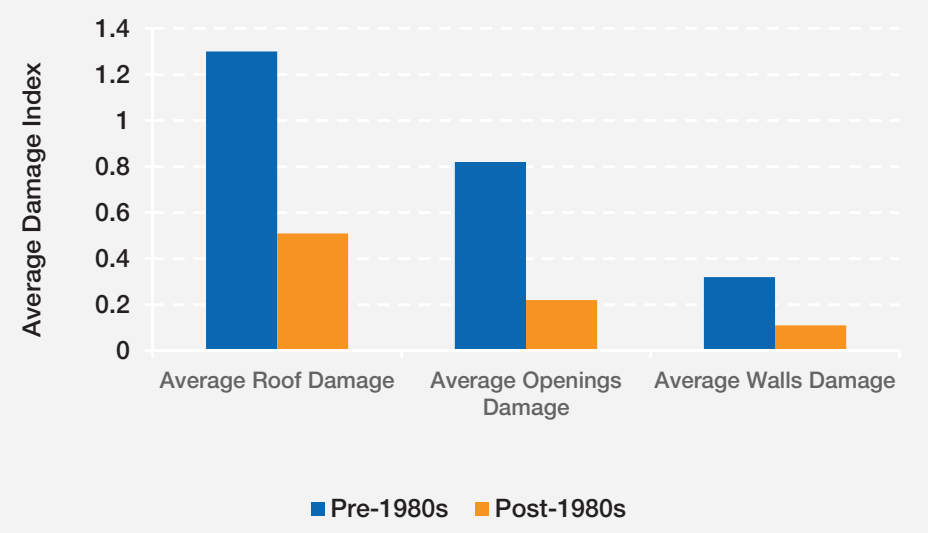
"It became clear garage doors were a point of weakness during Cyclone Yasi. As a result, our Technical Committee has updated the Australia/New Zealand Standard to improve building resilience."

Mr Colin Blair

Chief Executive Officer, Standards Australia[iii]

Tropical Cyclone Yasi makes landfall near Mission Beach in northern Queensland, on 3rd February 2011, with an estimated damage bill of $6.8bn to the state of QLD, compared to $1.5bn for Tropical Cyclone Larry five years earlier.[iv] The CTS Technical Report TR57 (Tropical Cyclone Yasi, Structural Damage to Buildings, April 2011[v]) showed that across the study area, less than 3 percent of post-1980 housing sustained significant roof damage. In this report, the CTS produced a suite of recommendations, including changes to four Australian Standards (e.g. AS/NZS 4505: 2012 garage doors and other large access doors), with the Report identifying a significant roller door failure rate of 29 percent during Yasi.

TROPICAL CYCLONE YASI AVERAGE DAMAGE INDEX



Source: Cyclone Testing Station Technical Report No 57, Tropical Cyclone Yasi - Structural Damage to Buildings, April 2011. (1,963 homes surveyed, 592 constructed prior to the 1980s, 1,371 classified as post-1980s construction).

Importantly, the CTS has also worked on the unification of testing methods for cyclonic wind loading across WA, NT and QLD, as in the past, testing was unstructured and not based on sound testing and research methodologies. This resulted in the Low/High/Low Test Method, a Cyclic Test Method for Cyclonic Regions relating to fastening metal roofing, which has been incorporated in the BCA.

It is important to note that the contribution of the CTS to the residential building industry has had significant impact upon non-cyclonic areas as well as cyclone affected areas; as both have minimum building standards to which buildings must adhere.

The CTS also informs the insurance industry, acting as a key body able to provide information and background to the way insurers assess risk, both in terms of structures and communities. As an example, the CTS has been funded by The Insurance Council of Australia to conduct research that aims to identify the key exposures of strata-titled property that may be causing insurable losses, following increases of up to 800 percent in the cost of insuring these types of buildings in the wake of Tropical Cyclone Yasi.[vi]

As a demonstration of the ongoing and potential future impact of research to communities in cyclone-prone areas, the CTS is currently undertaking a significant long-term project to improve knowledge of wind speeds, as at the present time less than 2 percent of peak wind speeds of cyclones making landfall in Australia have crossed where there is a capability to measure them.[vii]

The research of the CTS has had a direct and significant impact on our understanding of the extent to which cyclonic events affect buildings. Their research has provided the important evidence to change Australian Standards and the way low rise buildings are constructed. The most significant and valuable impacts of the CTS research – the safety of people living in the tropics and the reduction in the extent of damage to their homes - is difficult to accurately quantify. It is however reasonable to say that the work of the CTS has deeply impacted and extensively influenced the standards, materials and practices of the Australian building industry, and the sustainability of built assets in tropical regions of the world.

"During Cyclone Yasi, homes built to the current wind load standards generally performed well."

Queensland Reconstruction Authority[viii]

"The CTS acts as a co-ordination point for a unified, aligned view of what testing requirements should look like for cyclonic regions, and what the main issues to address from cyclone events really are."

Mr John Kralic

Manager Lysaght Technology, BlueScope Steel

"Emerging trends or changes in risk are identified before they become a real problem."

Mr Mark Leplastrier

Manager Natural Perils, IAG

Photo Source: Cyclone Testing Station

THE IMPORTANCE OF BACKPACKERS TO TOURISM IN AUSTRALIA

TOURISM RESEARCH

Introduction

Tourism is a significant industry in the Australian economy. According to Tourism Australia, in 2012 it provided 11.6 percent of Australia's total exports, and 5 percent of our total employment. Backpacker tourism accounts for 9.92 percent of all visitor numbers to Australia. Significantly, backpackers, while representing only 10 percent of total tourist numbers, contribute 16.54 percent of total tourist expenditure.

Pioneering research undertaken in the early 1990s by Professor Philip Pearce (Pearce) and Associate Professor Laurie Murphy (Murphy) at James Cook University (JCU) had a significant impact on the way that the backpacker market was understood and responded to by the Australian Government, its tourism development agencies, and by tourism enterprises themselves. The success of backpacker tourism in Australia is founded to a large degree on this innovative research, which was some of Australia's earliest tourism research. The transfer of the findings of that research through tourism bodies, government policy and expenditure, has led to the growth and sustainability of backpacker tourism in Australia.

James Cook University was a pioneer in the development of tourism as a subject of study and established the first Tourism school in Australia's university system. The number of JCU completions of the Tourism undergraduate degree (to 2012) has grown by 864 percent, or 8.6. times, since 1992.

Early research undertaken within the School made a significant finding, identifying that the backpacker market contributed more to the Australian economy per tourist than any other tourist sector. Critically, the higher expenditure is an outcome of the extended length of time that a backpacker tourist remains within the country.

The backpacker research undertaken by the Tourism School at JCU over the last two decades is an outstanding example of the way that research institutions can develop novel findings in research that deeply influence government and the direction of their policy and strategies. It is also an example of the way in which government, industries and universities can collaborate both formally and informally to accelerate the transfer of research findings to policy and impacts upon the tourist sector, small-to-medium enterprises (SMEs) that operate within that sector, and the broader economy.

The rapid uptake of research findings and the depth of impact that the research had on the backpacker tourist market has strong implications for our understandings of the importance of research and the manner in which research impacts can deeply affect policy and economic growth in Australian industry.

"The research changed the way that the industry and government saw the contribution of backpackers from a low base to a high overall spend. As a result there was a real swing in our thinking at the time."

Professor Leo Jago
Chief Economist, Tourism
General Manager, Tourism Research Australia; Department of Resources, Energy and Tourism

Above: Professor Philip Pearce

"The early research at JCU was incredibly important, because it provided evidence for those seeking to develop businesses to then approach banks and business partners, and demonstrate that here was an industry worth investing in."

Mr Warren Gardner
Founder and Publisher of Aussie Backpacker magazine, an industry journal

Initial impacts of the research

In the early 1990s, two pieces of seminal research from JCU made findings that continue to deeply influence our understanding of the nature and character of the Australian tourist market. This research overcame a significant obstacle in our understanding of the economic value of the Australian tourist market. Prior to this research, the backpacker tourist market was seen as a marginal component of the tourist industry, one that was incorrectly viewed as an area of little commercial value, and certainly not a component of the market that should be promoted in any systematic way by government or industry-based tourist development agencies. The backpacker tourist segment was underestimated in terms of their economic impact, especially to regional and remote areas of Australia that are not typical destinations for other tourist segments.

This early research by Pearce and Murphy found that the backpacker tourist was indeed a significant component of the Australian tourist market and surprisingly, a particularly valuable part of the tourist market.

Impacts on Policy and Practices

The Tourism School at James Cook University led by Professor Philip Pearce, with other researchers including Associate Professor Laurie Murphy, found an immediate audience for the transfer of their research findings into tourism development agencies and into industries surrounding the backpacker market.

The establishment of the Tourism School at JCU also had effects beyond research. It trained undergraduates in preparation for roles in the growing tourism industry in Australia. Graduates from the JCU School of Tourism found positions both within the regional economy in tourist operations and in tourism policy and development organisations nationally - at both State and Federal Government level - as well as internationally.

Staff and graduates of JCU's Tourism School were also invited to participate in governance structures for tourism agencies, for example, Associate Professor Laurie Murphy was invited to participate in the National Backpacker Tourism Strategy (1995) and was a member of the newly formed Commonwealth Department of Backpacker Tourism arising from that strategy.

"I was aware that the policy arm of the Department of Tourism was deeply influenced by the research".

Ms Allison Rossetto
Lecturer, formerly Principal Analyst
Bureau of Tourism Research

"JCU has developed distinctive strengths in PhD training and education in tourism, with 40 graduates completing this advanced program, having significant influence in education and industry throughout Australia and the Asia Pacific region."

Professor Philip Pearce
Head of Discipline – Tourism, Events & Sports and Foundation Professor of Tourism, James Cook University

"The cohorts coming out of JCU over the years have definitely influenced policy direction in the tourism discipline. At the time I was working in tourism policy in the 1990s, I can recall 5 or 6 other JCU graduates working with me. Early JCU tourism graduates also worked in local government tourism operations throughout tropical Queensland."

Ms Allison Rossetto
Lecturer, formerly Principal Analyst
Bureau of Tourism Research

Moreover, the research undertaken into the backpacker market in Australia has influenced the direction of policy at the federal level with tourist development initiatives directed precisely at the backpacker market in Australia.

Current impacts of research

Backpacker tourism is a significant component of the Australian tourist market. The economic contribution made by backpackers is greater than its proportion of the number of total tourists visiting Australia, which is still significant at 10 percent of all tourists.

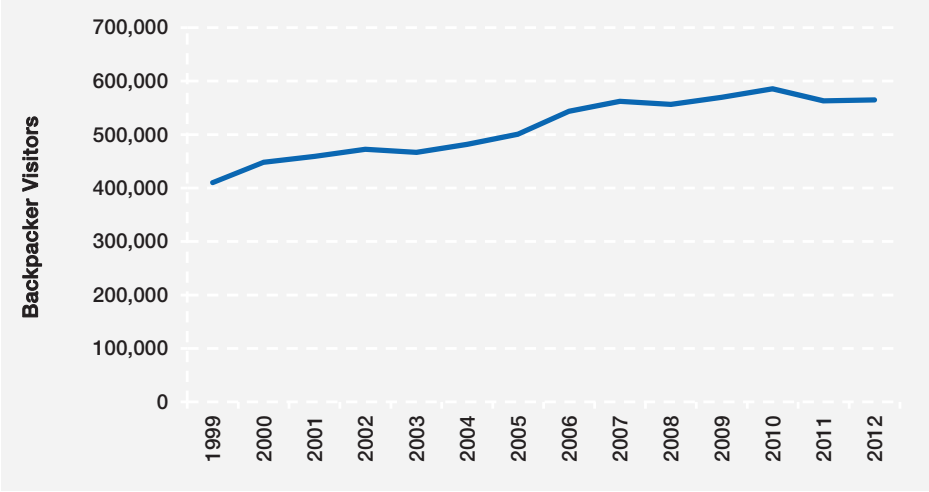
The growth of backpacker tourism in Australia is demonstrated in Figure 1 below. The number of backpackers visiting Australia in 1999 was 410,117; growing to 564,657 in 2012 - a growth of 37.68 percent over this time.

The growth and sustainability of the backpacker segment of the Australian tourist market is the outcome of an ongoing strategy by tourist development agencies promoting Australia's backpacker tourist attractions and accommodation. Successive Federal and State Governments have promoted this sector, and the promotion of Australia as a destination to backpacker tourists continues today.

"The research certainly had value strategically and tactically in developing our marketing plan for tourism. It was applied directly by our Tourism Department and enabled me at a strategic level to engage with the Board in reporting on the focus and direction of our marketing strategies."

Ms Glenys Schuntner

CEO, Regional Development Australia Townsville and North West Queensland Inc., formerly CEO of Townsville Enterprise Limited



Left: Figure 1, Number of Backpackers to Australia 1999 to 2012.

Source: Tourism Research Australia 2013 (unpublished data).

Backpacker Tourism remains a focus for peak national tourism bodies, for example Tourism Australia's 'Best Jobs in Australia' campaign, a $4m global strategy directly targeting the backpacker market, in an effort to attract them to fill part-time vacancies in tourism and hospitality markets. More than 40,000 applications were received.

Source: Tourism Australia 2013

The innovation of backpacker tourism research can be clearly attributed and linked to the original and continuining research of Pearce and his colleages at JCU. The success and importance of backpacker tourism in the Australian economy is an outcome of the development of strategies and policies seeking to promote Australia as a destination to this cohort of tourists. The identification and early evidence of the economic value of this market segment by Pearce directly impacted on the perception of the market and changed the way the Australian tourism industry promoted itself and identified backpackers as a strategic target in the ongoing success of the Australian tourism industry.

The impact of the research is instructive to understanding how research findings can influence policy and tourism strategy, and it also reveals how researchers can be important thought leaders and collaborators with government and industry to develop new markets and increase Australia's productivity.

The influence of the backpacker tourism research, begun in the early 1990s, has enduring and significant impacts upon this substantial export industry.

"Philip Pearce played an instrumental role in the formaton of the Council of University Tourism Education, which has enhanced the teaching and research of tourism studies in Australia."

Professor Leo Jago
Chief Economist, Tourism
General Manager, Toursm Research Australia; Department of Resources, Energy and Tourism

	Output	Employment FTE	Income $m	Value added $m
Initial	2,604.35	14,510	776.51	1,230.20
Flow-on	5,082.67	18,044	1,178.90	2,442.89
Total	7,687.02	32,554	1,955.40	3,673.08

Left: The economic impact of backpacker expenditure to Australia in 2012.

Note: The economic impact of backpacker expenditure for 2012 was calculated using unpublished data from Tourism Research Australia.

BUILDING CAPACITY IN INDIGENOUS COMMUNITIES

EMPOWERMENT RESEARCH PROGRAM

"Solutions lie with the people in the community. And as the people are being able to participate in finding their own solutions, then you can see that there's going to be success." Rev Les Baird, commenting on community-centred empowerment programs in Yarrabah[i].

Introduction

Research at The Cairns Institute based at James Cook University has had far-reaching impacts on one of Australia's most significant problems: the health and wellbeing of its Aboriginal and Torres Strait Islander (hereafter Indigenous) population.

In establishing The Cairns Institute (the Institute), a centre for advanced studies in the social sciences and humanities, James Cook University (JCU) has contributed to significant achievements in research that deeply impacts our society in Australia, and the world.

Professor Komla Tsey (Tsey) was appointed by the Institute as Tropical Leader, Education for Social Sustainability in 2011; one of six Tropical Leaders amongst a cohort of national and international scholars. He has developed and led the Empowerment Research Program (ERP), a sustained activity for the past 12 years; firstly at the University of Queensland and moving to JCU in 2006. The ERP represents a collaboration between multiple universities, organisations and community groups; led by Professor Tsey. This case study seeks to demonstrate the achievements of the ERP network over the longer term and acknowledges the contribution of its partners in research.

The Indigenous people of Australia have suffered significant loss of their culture and identity which has deeply impacted and inhibited their capacity for taking control of their lives and addressing the significant challenges they face across the spectrum of healthcare, education, employment and social wellbeing.

Attempts to improve the health and wellbeing of Indigenous peoples by the Australian Government have been largely unsuccessful as they have focussed on social determinants such as drug & alcohol abuse, domestic violence, child welfare, incarceration and suicide – or symptoms of the problem - rather than addressing the underlying cause of the problem, which is a deep sense of hopelessness amongst Indigenous Australians arising from displacement, grief and loss. The failure of previous programs has been due to their lack of relevance to Indigenous Australians, which is a key feature of the method of research outlined in this case study.

The definition of "Aboriginal Health" in the Constitution of the National Aboriginal Community Controlled Health Organisation (NACCHO):

"Aboriginal health" means not just the physical well-being of an individual but refers to the social, emotional and cultural well-being of the whole Community in which each individual is able to achieve their full potential as a human being thereby bringing about the total well-being of their Community. It is a whole of life view and includes the cyclical concept of life-death-life."[ii]

Definitions of Empowerment and Wellbeing:

Empowerment is "a strategy that directly addresses lack of control over destiny. Through challenging social and physical risk factors in a collective setting, people gain a belief they can control their worlds, a sense of their commonality, an ability to work together to acquire resources, and an actual transformation of socio-political condition."(Wallerstein, 1992)[iii]

The premise of the ERP is to develop programs that address healthcare issues by seeking to build capacity in Indigenous communities, taking a healing and participative approach to improving the determinants of Aboriginal health and wellbeing.

This highly respectful and collaborative approach to research, which seeks to understand the concepts and processes of empowerment through individual experiences, deeply resonates with Indigenous Australians, and is the method by which individuals and communities are empowered.

The hallmark of ERP is that the research team works alongside individuals and communities to help them identify, confront, and appropriately process the challenges they face, and be supported in their capacity to effect change and address the problems that so deeply impact upon their lives and those they are in relationship with.

"Empowerment and capacity building strategies produce outcomes at an individual, community, organisation and political level and are universally relevant across the broad spectrum of Indigenous health, education, child safety, employment, drug and alcohol treatment and prevention, and workforce development." [iv]

Professor Komla Tsey

Impacts of the research

The ERP team has contributed extensively to the stock of knowledge in the disciplines of social science and Indigenous health, both nationally and internationally. The impact of the research has extended beyond theory, being embedded in curricula and the practice of a significant number of agencies engaged in providing Indigenous services.

Contributions to the field of Indigenous empowerment research by Professor Komla Tsey's ERP team and their collaborators

- Produced over 100 peer-reviewed journal articles, book chapters and commissioned research reports.
- Secured highly competitive grants for four current research projects, focussing on quantifiable health and wellbeing benefits including economic evaluation. The four grants total $1.7 million, funding research from 2010-2015. Three of the grants are from the National Health Medical Research Council and focus on alcohol misuse, dependence and reducing alcohol related harm, and the fourth is an Australian Research Council Discovery Indigenous Award, focussing on the role of targeted mentoring support, building resilience in Indigenous youth.
- Supervised 12 PhD and Masters completions to date.
- Mentored 18 Indigenous researchers through a $2.2 million 5-year NHMRC Building Indigenous Research Capcity (BIRC) project.
- Provided over 100 presentations including local, national and international invited and key notes.
- Professor Tsey was awarded the prestigious Australian National Health and Medical Research Council (NHMRC) Population Health Research Career Development Award in 2005, and the AJ Thompson Award for Good Practice in Public Health 1994 by the Public Health Association of Australia.
- The ERP team has grown since inception to comprise eight specialists in mental health empowerment.

Above: Professor Komla Tsey

"Back in 1999, when I was delivering a degree program on Thursday Island, what was captured by the early research of the ERP team was extraordinarily profound around the concepts of recovery, and totally revolutionised my understanding of mental health for Indigenous people."

Associate Professor Melissa Haswell-Elkins
School of Public Health, University of New South Wales

Community impacts of Empowerment Research: it changes lives

The Family Wellbeing Program

The Family Wellbeing Program (FWB), a nationally-accredited course, is one of the key programs used by the Empowerment Research Team to foster empowerment and promote wellbeing in Indigenous communities.

FWB was developed in the early 1990s by a group of Indigenous leaders in Adelaide who had been affected by the Stolen Generations*, to enhance the capacity of Indigenous Australians to more effectively address the social determinants of their health[v].

In 1998, Professor Tsey was invited by Tangentyere Council, an Aboriginal community-controlled organisation in Alice Springs, to evaluate a course of FWB run as one element of a series of community responses to prevent youth suicide[vi]. Since 2000, following the success of early pilot programs of FWB, Tsey and the Empowerment Research Program team, in collaboration with government and non-government service providers, have built upon and sustained the Program. The ERP team has mapped the uptake of the FWB to 2013. It has been delivered to 3300 people (91 percent Aboriginal and Torres Strait Islander) across 56 communities Australia-wide. Within those 56 communities, there were 206 discrete FWB program deliveries[vii]. The ERP has extended the delivery of Family Wellbeing to Indigenous communities in Papua New Guinea, Rural Ghana, and Canada.

The main strength of the FWB program is that it was developed by Indigenous people, for Indigenous people, and so it has great relevance, adoption and sustainability in Indigenous health program delivery. It is delivered through five 30 hour stages and is premised on the idea that all humans have basic physical, emotional, mental and spiritual needs; and that failure to satisfy these needs results in behaviour problems[vi]. Family Wellbeing skills are not unique in themselves - they are mainly generic analytical and problem-solving skills that are typically learned within the family and/or school. What is unique about the Family Wellbeing approach is that it sets out to teach these skills implicitly.[vi]

The FWB is nationally recognised as a 'success story' in Indigenous Australian health[viii]. It has wide applicability and relevance to a broad spectrum of people, communities and agencies, being adapted by the ERP team for delivery to clients as diverse as 'at-risk' Indigenous youth, Forensic Psychiatry students at Masters level, and staff at welfare agencies. It is also highly adaptable for addressing the needs of other disadvantaged groups in society.

"The FWB was the first program I evaluated in Australia that was developed by Aboriginal people in response to their own specified need… It was the most promising in terms of the potential to actually prevent illness and promote wellbeing."

Professor Komla Tsey[ix]

Family Wellbeing Program

Family Wellbeing Program

"A number of studies have favourably evaluated the effectiveness of the Family Wellbeing Program in increasing capacity and empowerment, improving social and emotional wellbeing and reducing violence in Indigenous communities. The reported success of the Family Wellbeing Program in addressing these issues has made it one of the most sought-after and recognised Indigenous empowerment and skill development programs…

It shows how communities can confront complex problems by drawing on holistic healing methods which blend cultural renewal and spirituality with conflict resolution and other problem solving skills."

Australian Human Rights Commission Social Justice Report, 2011[x]

Yarrabah

The impact of the research on communities is further demonstrated in considering the partnership of the ERP team with the vulnerable Indigenous community of Yarrabah, in Far North Queensland. Based on income, job status, occupation, personal qualifications, service availability and housing conditions, the community is Australia's most disadvantaged local government area[xi]. The vast majority of the population have been directly affected by the Stolen Generations policy.

Engaging with individuals and community

The ERP team has partnered with the Yarrabah Community since 2001, when Professor Tsey was invited to speak at a meeting of the Yaba Bimbie (Father-Son) Men's Group, and subsequently to deliver the FWB program. Yaba Bimbie had been established in 1997 in response to a spate of suicides and suicide attempts by young men in Yarrabah.

Contributing factors to suicide are complex, the reporting of its incidence difficult, and discussion of the topic highly sensitive. However, there is anecdotal evidence that the ERP has contributed to a reduction in suicides in Yarrabah and other Indigenous communities; by the core defining feature (and method) of the research, which is building capacity in individuals for improved resilience. In a review undertaken by the ERP team in 2000[vi], a close correlation was found between quality parenting, a primary focus of the FWB course, and young people's social and emotional wellbeing, a major factor in youth suicide.

Of central importance to Indigenous men is their autonomy – to have control over their activities, assume responsibility for the outcomes of their lives and their families, and to operate from a strong position of community connectedness. Through the work of the ERP and the delivery of the Family Wellbeing program, the men of Yarrabah have been able to gain understanding and control over the conditions affecting their lives, and have learned important life skills such as communication, problem solving and conflict resolution. This has enabled them to start to address issues of violence, alcohol & drug misuse, and over representation of Indigenous men in the criminal justice system, and seek improved health and education outcomes for themselves, their families and their communities.

As stated by McCalman et al[xii], qualitative research suggests that through promoting empowerment, wellbeing and social cohesion for men and their families, men's support groups may be saving costs through reduced expenditure on healthcare, welfare, and criminal justice costs, and higher earnings. Current research undertaken by the ERP team is seeking to demonstrate this empirically.

The positive response by members of the Yaba Bimbie Men's Group group to the intervention of the ERP provided the foundation for an ongoing research partnership between Yaba Bimbie and the ERP team.

Today, the Family Wellbeing Program is firmly embedded in the Yarrabah Community. In addition to the outcomes achieved through Men's Groups, both Guuriny Yealamucka Health Service (Guuriny) and Gindaja Treatment and Healing Indigenous Corporation (Gindaja) use FWB in their community programs. Gindaja has also undertaken a research program with ERP to demonstrate the cost effectiveness of providing an alcohol and drug rehabilitation program, and the ERP has funded 6 community-based research officer positions and supported successful advocacy to the Department of Health and Ageing (DOHA) for four recurrent research officer positions Guuriny.

Key Demographics	Yarrabah LGA	QLD	Total Australia
Percentage of population that is Indigenous	97.3%	3.6%	2.5%
Percentage of population aged 24 years and under	54.9%	33.8%	32.6%
Percentage of population undertaking tertiary education	1.9%	13.5%	14.3%
Weekly Median Income	$274	$587	$577
Unemployment Rate	61.8%	6.1%	5.6%

Source: ABS Census 2011

"The Empowerment and Wellbeing research has had a very powerful impact, especially with the men's groups in Yarrabah. Men have come into knowledge about what to do when faced with difficult challenges and circumstances in their lives, families and community, and make decisions to change."

Rev. Les Baird
Wontulp College and Yarrabah Community Elder

Beat da Binge Initiative

In 2011, the Gindaja Treatment and Healing Indigenous Corporation developed the "Beat da Binge" initiative in partnership with other local community organisations. The program was funded through the Federal Government's National Binge Drinking Strategy, and sought to understand why Indigenous youth drink at harmful levels.

The ERP team worked with the community to embed empowerment/wellbeing promotion as important parts of their binge drinking prevention initiative, and collaborated with specialist drug and alcohol researchers to design and implement the evaluation components of the project.

"The participation of the ERP team from JCU in the analysis and evaluation of the Beat da Binge study undoubtedly brought a lot more depth to the project."

Michelle Singleton,
Project Coordinator at Gindaja Treatment & Healing Service and member of the Yarrabah community.

The project resulted in[xiii]:

- 16 percent reduction in binge drinking
- 27 percent increase in awareness of binge drinking.

Importantly, the research team were able to identify what the young people meant by saying "we drink because we are bored." Being "bored" was defined as feeling a lack of purpose or meaning in life, training, employment or activities. Being able to define the core problem, the participants in the study were then able to articulate possible solutions, e.g. the importance of mentoring to young people by community leaders. This is a positive step forward for the 'at risk' group and provides further opportunity for the ERP team to continue its work in capacity building within the Yarrabah community.

The Gindaja Treatment and Healing Centre at Yarrabah in Far North Queensland won an Excellence in Services for Young People Award for the Beat da Binge Initiative. The award was presented at the 2013 National Drug and Alcohol Awards at Parliament House in Canberra. Details can be found at http://www.qnada.org.au/news/666/congratulations-to-gindaja-and-qld-police-service-on-drug-action-week-awards.

Impacts on Policy and Practices

The ERP team's research has impacted on the implementation of programs and services in national Indigenous health research practice, and influenced national Indigenous health agendas.

Professor Tsey's early contributions included identification of the importance of empowerment and social and emotional wellbeing, the importance of education as a determinant of health, and the importance of making research relevant to Indigenous Australians through research capacity building.[iv]

Although the FWB program itself has been an important vehicle for empowerment, it is the empowerment principles and attributes that have created change. The program's empowerment principles influence not only individual change but also the operational processes within organisations and policy, thus adding value to and beyond the program through developing policy-relevant evidence and advocacy.

Partnerships with community agencies

One particular impact of the research is its widespread adoption in multiple spheres, such as the uptake of the FWB by organisations as diverse as the Royal Flying Doctor Service, youth centres, hospitals and health services, drug & alcohol rehabilitation centres, child welfare agencies, schools, universities, and Indigenous men's and women's community groups. Partnerships have been established with agencies and organisations across Australia, and internationally.

An example of the types of outcomes achieved through such partnerships is the Royal Flying Doctor Service (RFDS), which has used the FWB program as the main community mental health wellbeing capacity development in the Gulf of Carpentaria, since 2009. The RFDS has also provided FWB to Indigenous staff in Cape York, and a range of health and human services staff and community members in the Gulf of Carpentaria.

The Royal Flying Doctor Service

"We selected the FWB program as it met two important needs as expressed by communities in our consultation with them – it provided accredited training through attainment of a Certificate II, and had a strong evidence base around having a positive impact in remote Aboriginal communities. It's actually very hard to find things that are relevant to Aboriginal people in very remote areas.

The outcomes of the FWB are that people report it enables them to look at their lives, their family life, and community life in a different way; and make changes … We've seen quite a few people change their own personal situation, particularly in moving into more satisfactory jobs, taking leadership roles in the community, and providing access to education."

Ms Ann Kreger
Senior Mental Health Nurse, Royal Flying Doctor Service, Gulf of Carpentaria.

Measurement of psychological distress - the Growth and Empowerment Measure (GEM)

The measurement of psychological distress through the Growth and Empowerment Measure (GEM) model quantifies the impacts of the ERP approach on individuals and their wellbeing.

The GEM is the first Indigenous specific psychosocial empowerment measure, developed by Associate Professor Melissa Haswell-Elkins, based at UNSW and a member of the extended ERP network; validated to assess the impact of the FWB. It uses an emotional empowerment scale, scenarios and the Kessler 6 Psychological Distress Scales to measure psychological and social empowerment, and it is highly sensitive to change (i.e. demonstrating very slight changes in feelings and the capacity to cope with challenges).

The GEM measure is being increasingly used to evaluate a wide variety of Indigenous health and wellbeing initiatives across Australia and beyond, and in time will present rigorous data around important outcomes of ERP research. The GEM can be adapted so that it can be applicable to various community groups, for example those undertaking drug & alcohol rehabilitation programs, attending youth centres, or undertaking reintegration programs from prison.

"Preliminary data on GEM suggest that the tool is collecting valid and reliable data on domains of empowerment that are relevant to Indigenous Australians and probably also to others… GEM clearly has direct relevance to mental health, a key issue in Indigenous Australian communities."

Associate Professor Melissa Haswell-Elkins
School of Public Health, University of New South Wales[xiv]

The GEM measurement has been used in a wide variety of spheres, including:

- Royal Flying Doctor Service in the evaluation of the Cape York Wellbeing Centres.
- University of New South Wales as a course evaluation for an Indigenous health elective under the Masters of Public Health.
- Lotus Glen Drug & Alcohol Service in Mareeba (Far North Queensland) as a systematic outcomes measure for clients, including post release follow-up over the long term to determine whether they continued to seek support for addiction and stayed out of the criminal justice system.
- Oolong House, a residential substance abuse treatment program in Nowra (NSW South Coast), which shows the GEM's applicability to the non-Indigenous population, as 40 percent of the Oolong clients are non-Indigenous.

Employment outcomes, developing capacity

As the research program has grown, emphasis has shifted to supporting early career researchers. The ERP has had direct impact in terms of research employment, as demonstrated in the table below. The percentage of Indigenous employment is indicated in brackets.

> For research to be relevant to the needs and aspirations of Indigenous Australians, Indigenous people themselves must be enabled through capacity enhancement to do their own research based on long-term partnerships."
>
> Professor Komla Tsey[xv]

Research Employment	2001/02	2006/07	2011/12
University-based research employment (FTE)	1.5 (0%)	8 (37.5%)	7 (60%)
Community-based research employment	0.15 (100%)	10 (90%)	0
Research staff (university or community-based) with PhD	1 (0%)	3 (0%)	5 (25%)
HDR students supported to PhD through the program	0	0	7
Research partner organisations	3	6	19

Source: Empowerment Research Program, The Cairns Institute

Above: Mens group, photo source JCU

Disempowerment manifests as social problems: Domestic violence, alcohol and drug abuse, sexual abuse, suicide, school absenteeism, lack of education, welfare dependency, unemployment and incarceration.

EMPOWERMENT RESEARCH PROGRAM

The concept of building capacity in the individual (whether that be a man, woman, child or adolescent) leads to enhanced capacity and outcomes for family, community, organisations and government. Examples of impact through ERP are outlined below.

Impacts to individuals & communities

Indigenous Men's Groups, (sustained by ERP over 12 years). Numbers attending men's groups may be small, but have significant reach and impact. As an example, of the 50-60 men who participated in men's group meetings in Innisfail (QLD) during 2004-05, leaders from those groups provided court support on 828 occasions[xii].

1

- Self-awareness, leading to capacity to change behaviour
- Seeking help instead of resorting to violence, drugs, alcohol or suicide
- Attainment of conflict resolution and leadership skills
- Taking responsibility for family, leading to reduced violence, and improved family wellbeing
- Achievement of formal qualifications in counselling by undertaking the Family Wellbeing Program
- Job readiness and access to greater employment opportunities
- Vision for a better community, promotion of strong culture, knowledge sharing with other communities and representation to local government.

2

Education is provided by FWB incorporated in curricula:

- Education Queensland curriculum for Grade 7 and 10 students in Cape York (Including transition to employment).
- Certificate level qualifications obtained at TAFE, Wontulp Bi-Buya Christian Indigenous College and in Child Protection for Department of Families (Cairns).
- James Cook University, Queensland – Master of Indigenous Studies/Master of Public Health.
- La Trobe University, Victoria - the Bachelor of Health Sciences/Master of Social Work.
- University of NSW – 'Aboriginal Health and Wellbeing across the Lifespan' delivered externally as one of three electives under a Masters in Public Health.
- University of Papua New Guinea – Master/Graduate Diploma in Public Health.

Impacts to agencies & Government

3

Workforce & organisational capacity is developed by embedding ERP in practice.

Examples of organisations and agencies who have partnered with ERP in Indigenous health and wellbeing programs, are:

- ACT for Kids, QLD
- Akeluyerre Healing Centre, Alice Springs
- Apunipima Cape York Health Council
- Catholic Education Service
- Gindaja Treatment and Healing Indigenous Corporation, Yarrabah
- Gurriny Yealamucka Health Service, Yarrabah
- Cape York Health and Hospital Service
- Hunter Medical Research Institute
- Institute for Urban Indigenous Health
- Kowanyama Aboriginal Shire Council
- Mareeba Alcohol Rehabilitation Service
- Menzies School of Health Research
- Mibbinbah National Health Promotion Charity for Indigenous Men
- National Drug & Alcohol Research Centre
- Queensland Department of Families
- Queensland Health Mental Health Services
- Royal Flying Doctor Service
- The Sax Institute
- Wontulp Bi-Buya Christian College, Cairns
- Yarrabah State School

4

Government policy and programs are informed by ERP representation to:

- National Advisory Committee for the National Empowerment Project, funded by the Commonwealth Department of Health and Ageing.
- Commonwealth Department of Health and Ageing Expert Reference Group, for the evaluation of Cape York Wellbeing Centres.
- National Health and Medical Research Council peer review panels.
- Queensland Medical Research External Advisory group.
- Lowitja Institute, Australia's National Institute for Aboriginal and Torres Strait Islander Health Research.

5

ERP has extended reach to other Indigenous communities of the world; for example Papua New Guinea, Rural Ghana and Canada.

6

ERP also has applicability for non-Indigenous communities in Australia and internationally.

7

Potential futures of empowerment and wellbeing lie in demonstrating social and economic impacts at a broader level.

Conclusion

The research undertaken by the ERP team over 12 years has significantly influenced service delivery in this most complex and urgent area of social disadvantage faced by Australia and its people.

According to the Parliament of Australia's Commonwealth Indigenous-specific expenditure 1968-2012 report[xvi], total direct Indigenous expenditure in 2010-11 was estimated to be $25.4 billion, accounting for 5.6 percent of total direct general government expenditure. It is vital that the effort invested in addressing the problems faced by our Indigenous peoples is directed where it can most achieve success.

Those working within the field of Australian Indigenous health and wellbeing operate within significant constraints, such as geographic isolation, the high cost of research and program delivery, changes to government at leadership and policy level, funding availability, and what can reasonably be achieved within the confines of agency structures. Interventions take a long time to translate into outcomes, with a significant amount of effort and resources required to achieve change that impacts at community level. The long-term partnership approach to empowerment research developed by the ERP team at The Cairns Institute creatively integrates micro community empowerment initiatives with macro policies and programs[v].

The ERP team has taken a 'phased' approach to its research, the notion that, if an area of research progresses systematically, there should be a shift over time from exploratory, mainly in-depth qualitative descriptive and theoretical research, towards more measurement and carefully evaluated interventional research.[iv]

ERP has made significant inroads in the provision of health and wellbeing services and to increasing the capacity of Indigenous communities. The wide-spread successes of the ERP clearly demonstrate the validity of the approach of effecting change at the level of the individual and community, which provides guidance for the development and delivery of other programs within Australia and beyond.

An exciting future for the ERP approach lies in the outcomes of its current research focus, which is extending the analysis from the individual and their wellbeing to demonstrating broader social impacts of this research through quantifiable improvements in areas such as decreased rates of abuse, suicide, and incarceration and increased access to education, higher levels of education, improved employment rates and higher income.

The Empowerment and Wellbeing Research Program exemplifies the research and engagement priorities of James Cook University's Tropical Strategy, and demonstrates how achievements through excellence in research can extensively impact upon peoples and societies in the tropics.

TOWARDS A SUSTAINABLE AGRICULTURAL FUTURE
CARBON FARMING TRIALS

Introduction

The challenge of environmental sustainability is one of the most critical issues we face in the world today. This challenge includes responding to the effects of climate change and managing our environmental assets in a sustainable way.

Food production, fundamental to human existence in an era of rapidly increasing global population, directly relies upon our successful management of environmental assets.

Agriculture is a critical industry for Australia. Its production value to the Australian economy in 2009-10 was $48.7bn with 307,000 employees, representing 3% of Gross Domestic Product (GDP). However, when all the economic activities supporting farm production are taken into account, the GDP contribution averages out at around 12%, or $155bn. Australia exports 60% of what it grows.[i]

This case study prospectively examines research that, in line with James Cook University's (JCU) Tropical Research Strategy, has the potential to impact upon both our response to climate change and the sustainability and productivity of agriculture in northern Queensland, tropical Australia, and the tropics more broadly.

The research seeks to provide evidence to demonstrate the effectiveness of biochar on crop productivity when it is introduced into soil in Far North Queensland farms. It aims to measure the increase in soil fertility and crop growth rates through the application of carbon and compost to agricultural soils. Additional benefits of biochar include the sequestering of carbon dioxide, potential decrease in nutrient run-offs, and the derivation of value from waste.

What is biochar?

Biochar is produced through a process called Pyrolysis. Biochar is the material that remains when organic matter (e.g. waste from sugarcane crops, municipal waste) is heated in the absence of oxygen. The process also results in bio-oils and bio-gases that can be used as an energy source.

The Hydrogen Pyrolysis Rig (Hypy) at JCU is one of only two instruments of its kind in the world that have the capacity to measure the carbon in biochar that will be stable on centennial timescales, and therefore the carbon that could potentially be claimed as a credit in a carbon market. It was purchased under Federation Fellow funding by Professor Bird in 2009.

Biochar has unique properties that make it not only a valuable soil amendment to sustainably increase soil health and productivity, but also an appropriate tool for sequestering atmospheric carbon dioxide in soils for the long term in an attempt to mitigate global warming.[ii]

Professor Michael Bird

Based at JCU's Cairns campus, Professor Michael Bird is an Australian Research Council Federation Fellow and Foundation Director of The Centre for Environmental and Sustainability Science (TESS). TESS includes over 40 researchers seeking to contribute knowledge to our understanding of natural and human systems in the tropics, providing evidence of rates and trajectories of change in these systems, and presenting solutions to the challenge of sustainable development in the tropics. Tropical eco-systems is one of JCU's major research themes.

There are multiple types of biochar. The variety and utility of biochar provides an opportunity for many new industries to be developed through specific applications. For example, in the contaminant removal sphere, coal-fired power stations produce substantial amounts of potentially contaminated waste water; and mines and refineries produce significant amounts of potentially trace-metal-contaminated spoil which then has to be re-vegetated. Some biochars have the capacity to remediate soil and water through their ability to strongly absorb contaminants.

About carbon farming research

This collaborative research project, led by Professor Michael Bird at JCU, and funded under the Federal Government's Carbon Farming Futures Program and Carbon Farming Initiative, has received $1.14m over three years, to:

i) Measure increased in soil resilience and crop yields and any decreases in greenhouse emissions.

ii) Develop a simple methodology to easily predict the stable carbon content of biochar, enabling land managers to understand carbon sequestration and participate in carbon markets.

The research aims to produce estimates of the carbon sequestration benefits of replacing fertiliser with compost, biochar and a compost/biochar mix in eight field trials across Australia's northern tropics. The crops to be tested include sugarcane, bananas, paw-paws and peanuts, to enable testing across several soil types. The project represents a collaborative effort with a number of organisations as shown in the table below.

Above: Professor Michael Bird

NATIONAL RESOURCE MANAGEMENT (NRM) GROUPS	BIOCHAR & COMPOST SUPPLIERS	(OTHER) INDUSTRY	FARMS
Terrain NRM, Innisfail QLD	Select Carbon (production of biochar)	Herbert Cane Productivity Services Ltd, Ingham QLD	Mr Joseph Marano (sugarcane), Mourilyan QLD
Northern Gulf NRM, Mareeba QLD	Black is Green Pty Ltd, Mackay QLD (biochar)	Peanut Company of Australia Pty Ltd, Kingaroy QLD	Bundaberg Sugar Limited, (farm operated by Messrs Alan Cross and Ian McDowell), Mareeba QLD
NQ Dry Tropics NRM, Townsville QLD	SITA Organics Pty Ltd, Cairns QLD (compost)		Pace Sugarcane Farm (Messrs Roy and Alan Pace), Mutarnee QLD
	King Brown Technologies Inc, Mareeba QLD (compost)		Wadda Banana Farms (managed by Mr Mark Gallagher), Innisfail QLD
	Renewable Carbon Resources Australia Pty Ltd, Charleville QLD (biochar)		Rigato Farms Pty Ltd (bananas) managed by Mr Dennis Rigato, Mareeba QLD
			Huon Gold Farms (paw paws), managed by Mr Michael Canzian, Dimbulah QLD
			Mr Michael Tomerini and Mr Ben Poggioli (peanuts), Tolga QLD
			Murat Agricultural (peanuts), Mr Paul Murat, Mareeba QLD

Potential Research Impact: Aims of the research project

The three priority areas of the research will focus on providing evidence of the efficacy and benefits of introducing biochar to particular soils, by:

1. Demonstrating the potential flow-on effects to agriculture:-

i) Healthier soils and increased soil carbon in northern tropical Australia;

ii) Less use of synthetic fertilisers and reduced risk of nutrient runoff to the Great Barrier Reef;

iii) Sustainable use of municipal organic waste, e.g. a component of the biochar supply for the project will be produced from plantation timber ruined for commercial use by Cyclone Yasi.

2. Quantifying the impact of reduced nitrous oxide emissions, as improved nitrogen retention has been demonstrated in biochar-amended composts.

3. Providing the data from which to develop modelling of the impact on carbon stocks and greenhouse gas emissions.

An immediate outcome of the research is the employment of five staff, providing a platform for building human capital and skillsets, critical to the development of a sustainable biochar industry in tropical Australia.

What are the potential benefits of biochar?

- improves soil fertility and nutrient retention
- increases crop yields
- being porous, it has significant water-holding capacity (thereby reducing the need for irrigation)
- reduces nitrous oxide emissions (a greenhouse gas)
- derives value from waste streams (e.g. green waste, algae, municipal waste)
- power station waste water remediation (trace element sorption)
- remediation of soil on mine sites
- produces 'carbon negative' energy from waste biomass.

The research features effective collaboration through the solid partnerships that have been established with National Resource Management groups, industry groups, entrepreneurial carbon enterprises, and individual farmers. Importantly, outcomes from the research will contribute to the body of evidence within the Australian carbon industry, and inform Australia's participation in global discussions and endeavours in this emerging and critical industry. At present, Australia does not have a peak biochar body - but is guided by the International Biochar Initiative (IBI).

"The research project demonstrates an effective relationship between research organisations, National Resource Management groups, and 'on-the-ground' organisations. As an NRM we don't have the capability of the dedicated research teams based at JCU, and JCU doesn't have the capacity of talking to the farmers as we do; so it's very worthwhile and beneficial to all stakeholders."

Kristjan Sorensen,
Northern Gulf NRM.

Potential Research Impact: Change in farming practices and government policy

Providing evidence to influence farming practices

Agriculture in Queensland represents nearly 3% of the state's Gross Regional Product (GRP)[iii]. The productivity, profitability and sustainability of Queensland's farms are closely inter-related and critical to the State's prosperity and quality of life of its people.

Although carbon farming as an industry is still in its infancy in Australia, the sequestration of carbon into soil is considered to be a potential next generation of farming, presenting an alternative to existing agricultural practices and ensuring the health and sustainability of the land and the agricultural enterprise it supports.

This research project is highly relevant to north Queensland, with favourable growing conditions provided by its tropical climate, high rainfall, large land area, and therefore large potential biomass supply. It also demonstrates the potential use of existing efficient agricultural infrastructure, e.g. the sugarcane railway network, which could support the co-location of pyrolysis plants with existing mills.

The research aims to provide a methodology to farmers for quantifying the stable content of biochar so that they can potentially earn carbon credits under the Federal Government's Carbon Farming Initiative (CFI). The arrival of a methodology is critical as carbon in vegetation or soils can only offset emissions if it is stored permanently.[iv]

The research also seeks to model new biochar farming systems, demonstrating benefits and costs at the farm and industry/regional scale, following interviews conducted with key participants in the industry and supply chain including farmers, agronomic advisors, compost and biochar manufacturers.

Providing evidence to influence policy

The potential impacts of the research align with Federal Government initiatives seeking to develop responses to climate change, energy challenges and the potential for new industry.

The importance of agricultural sustainability to the future of Australia is demonstrated in the Federal Government's level of investment in carbon farming research, which in turn will drive investment in renewable energy. The Carbon Farming Futures program, from which this research project is funded, is providing a total of $429m funding over six years to 15 grant recipients, and is part of the Federal Government's $1.7bn Land Sector Package under the Clean Energy Future Plan.

"The research at JCU is critical to validate the industry, as there has been no agreed methodology (to measure the fixed carbon in biochar) released under the Government's Carbon Farming Initiatives to date. As innovators in the biochar industry, we are very keen for a methodology to be agreed upon.

Daryl Killin
Select Carbon

"These trials are an important part of the process in turning research into real world practices for use across the agriculture sector."

Senator Joe Ludwig,
Minister for Agriculture, Fisheries & Forestry, commenting on Carbon Farming Futures Program farm trials in DAFF Media Release 8th April 2013

Creation of a New Industry

This research plays a critical role in contributing to the national and international body of empirical evidence that holds significant potential for Australia's economy by attracting investment, generating new industry, increasing trade, creating employment and enhancing the sustainability of agriculture.

> "In the biochar domain it is really a more applied focus in terms of finding solutions that are going to be appropriate for sustainable agriculture into the future, and that has to happen in parallel with entrepreneurial endeavour."
>
> Professor Michael Bird

In considering the types and scale of prospective enterprises around biochar, it is important to note there are numerous types of biochar for particular purposes. Significant opportunities lie in the optimisation of the biochar industry by SMEs[vi], particularly in producing customised biochar to particular end-users, whether that is in agricultural production or remediation, and creating "value added" products (e.g. combined with mulch and living bio products that can be used in a broadacre sense by cropping industries, and potentially as livestock feed.)

Biochar also offers potential in generating electricity and in conversion to fuel substitutes and in the remediation of mining and urban industrial sites in Australia.

Carbon Entrepreneurs

Entrepreneurs are already playing a critical role in putting the research into practice by developing a new industry. Four biochar producers, Select Carbon, Earth Systems, Renewable Carbon Resources Australia and Black is Green Pty Ltd are closely associated with this research project and are well-placed to provide a rapid uptake of the research findings.

Earth Systems, a multi-disciplinary environmental firm, had developed a mobile pyrolysis unit, the 'Charmaker MPP' under Victorian Government funding in 2009, which has the capacity to make the large amounts of biochar required for each farm trial. The 'Charmaker MPP' is 'world-first' technology, allowing pyrolysis to be undertaken at the site where green waste is located, removing the need for the transportation of large amounts of waste.

Select Carbon, a Recognised Offsets Entity under the Carbon Farming Initiative (CFI) based in Cairns, is pioneering the production and use of biochar from sustainable sources in north Queensland. Select Carbon has purchased the first 'Charmaker MPP' unit, which will continue to be used for producing biochar for the research farm trials.

These companies play a critical role in the supply of biochar to the project, and all recognise the opportunities presented by the myriad uses and benefits of biochar. They also recognise the importance of research in providing evidence for further investment and the creation of a biochar market on a large scale.

This project demonstrates the valuable role JCU plays in transferring basic science into applied research which provides evidence of the effectiveness of the technology in this emerging industry.

> "The JCU research project, placed possibly the largest biochar order in Australia to date, which created an opportunity for my technology to be put to commercial use, and generated employment. By participating in research and developing the technology, we are pushing the market, making biochar affordable, and providing other organisations with opportunities."
>
> Adrian Morphett
> Earth Systems

> "Select Carbon is bearing the risk and cost of being an early adopter as we know that in biochar, we have a sustainable niche product in the tropics."
>
> Daryl Killin
> Director of Select Carbon and a Professional Forester of the Institute of Foresters of Australia (IFA).

> "The research being undertaken by Professor Bird and associates at JCU is critical to the emerging biochar industry and to northern Queensland, as it seeks to provide vital evidence and methodologies around the stability of carbon in soil, crop yields and response of particular soil types and crops."
>
> Daryl Killin
> Select Carbon

A demonstration of potential outcomes: sugarcane

Western Research Institute (WRI) has modelled the cost of biochar and included this in the Appendix 'An economic assessment of biochar: the case for sugarcane' found on Page 97.

The suitability of biochar application in agriculture has been examined in the context of sugarcane production at one of the farms participating in the research project, owned and operated by Mr Joe Marano in Mourilyan, north Queensland. Specifically, the possibility of using biochar as a supplement or substitute to conventional mineral fertilisers was examined and the cost effectiveness of biochar usage was considered.

Under an optimistic scenario, the use of biochar for soil improvement in sugarcane becomes economically viable seven years after the application of biochar to the soil.

"What Professor Bird is doing has relevance to all tropical regions on the planet – that's where JCU can be a world leader in tropical agriculture, and tropical soils."

Kristjan Sorensen
Sustainable Industries Officer,
Regional Landcare Facilitator,
Northern Gulf Resource Management Group.

Conclusion

The importance of the research being undertaken by Professor Bird and colleagues at James Cook University is that it is providing solutions for the future of tropical Australia.

This research demonstrates the importance of JCU's contribution to its region, nationally and internationally.

Through this research, JCU is seeking to provide solutions to some of the most challenging issues the world confronts: climate change and environmental sustainability. At a time when food production and Australia's role in food production is emerging as an important future industry, coupled with political calls for North Australia's economic expansion, JCU is providing the expertise in basic science required to provide evidence for technical solutions to improve soil, increase agricultural productivity and reduce greenhouse gas emissions. It also provides the human capital in terms of research skills to provide evidence critical to the development of a new sustainable industry around biochar.

"Research like this is very important to each little town along the Queensland coast that's reliant on farming – whether that's sugarcane, bananas, or other crops. We all need to be sustainable and profitable – and if we can't increase our production or save on input costs, we are going backwards. And a thriving sugar industry helps all the other industries in Queensland. We want outcome-based research – if it's proven that it's worthwhile economically, that it will make a difference to production, and it's sustainable, the farming industry will give it a go."

Joe Marano
Director of Canegrowers Innisfail,
Director of CaneGrowers Queensland, and owner of sugarcane farm involved in the biochar farm trials

Source: Earth Systems, Charmaker MPP

3.3 IMPACTS OF RESEARCH CONCLUSION

The research impact case studies reveal another dimension of the effects a university has on its region. JCU's tropical strategy is perfectly aligned to its regional location. The research impact case studies demonstrate how a university can affect its region beyond the demonstrable economic and human capital impacts. Universities, with their inherent research capacity, investigate and provide evidence to improve health outcomes (Ear Trial and Empowerment Research Program), safety (Cyclone Testing Station), and economic development (Backpacker Tourism).

The research impact studies demonstrate the delivery of JCU to its proposed Tropical Strategy. In each of the case studies we can see evidence of JCU's aim for research excellence and impact.

The CTS has a sustained research effort seeking to improve the safety and conditions for people and their homes and other low-rise buildings in the tropics. Tourism is an important component of Northern Australian economy and the identification of the backpacker market in Australia by Professor Philip Pearce and Associate Professor Laurie Murphy and the incorporation of these findings into policy and tourism promotion strategies has supported the growth of backpacker tourism in Northern Queensland and Australia. The health and wellbeing of people in the tropics have been improved through the research into chronic middle ear infections and empowerment of Indigenous communities.

The case of carbon farming demonstrates how critical JCU will be in the future of tropical Australia. At a time when northern Australia is being viewed as critical to the economic growth of the nation, JCU's role in providing research expertise becomes all the more important. The Carbon Farming case study demonstrates how the application of science can provide the evidence essential to the development of a new sustainable industry.

The research impacts demonstrate that JCU's contribution far exceeds an economic and human capital value. Research capacity in Northern Australia provides a flexible capability that can be direction to some of the most significant challenges and issues that confront the region. Research capacity in itself provides a vital part of the infrastructure for Australia to sustain the environment, economies and population of tropical Australia.

Photo source: James Cook University

CONCLUSION

5. CONCLUSION

5.1 IMPACTS ON THE REGIONAL AND STATE ECONOMIES

James Cook University plays an important role in the economy of Queensland. It is estimated that JCU contributed $538.9 million to the Gross State Product of Queensland in 2011 and $587.1 million in 2012 when flow-on effects are taken into account. The tables below summarise the economic impact of JCU on the local economy.

2011 Economic Impact of JCU when flow-on effects are taken into account.

	Employment FTE	Household Income $m	Value added $m
Queensland	4,332	307.8	538.9
Cairns LGA	1,027	70.7	120.1
Townsville LGA	2,821	203.1	352.4

2012 Economic Impact of JCU when flow-on effects are taken into account.

	Employment FTE	Household Income $m	Value added $m
Queensland	4,862	350.2	587.1
Cairns LGA	1,148	80.6	137.5
Townsville LGA	3,138	228.9	398.0

- It is estimated that JCU contributed $120.1 million to the Gross Regional Product of Cairns LGA in 2011 and $137.5 million in 2012.
- It is estimated that JCU contributed $352.4 million to the Gross Regional Product of Townsville LGA in 2011 and $398.0 million in 2012.

The key sectors impacted in terms of FTE employment

At the state level key sectors impacted included:

- Retail trade;
- Hospitality; and
- Health and Community Services.

At the Cairns LGA level key sectors impacted included:

- Retail trade;
- Hospitality; and
- Construction.

At the Townsville LGA level key sectors impacted included:

- Retail trade;
- Health and community services; and
- Hospitality.

In light of the above, JCU plays a vital role in the contribution to Gross Regional Product in Cairns and Townsville and to Gross State Product in Queensland.

5.2 CONTRIBUTION TO HUMAN CAPITAL

The contribution to human capital by JCU is an important catalyst for growth in the region. The human capital analysis indicates that the total public and private value of graduates that completed studies at JCU in 2011 (over their working life) is approximately $1.16 billion. This comprises:

- approximately $614.0 million in total private or employee captured value; and
- approximately $546.9 million in total public value, representing the value the graduate generates for the respective employer.

The presence of graduates in a region demonstrably contributes to productivity, higher wages and lower unemployment rates. JCU provides regional educational opportunities to residents of north Queensland who would otherwise have limited access to those opportunities. The ongoing graduation of students from JCU creates a pipeline of human capital supporting the region, its economic development and sustainability into the future.

5.3 IMPACT OF RESEARCH

The research impact case studies demonstrate the delivery of JCU to its Tropical Strategy. Each case study demonstrates evidence of JCU's aim for research excellence and impact.

The CTS has a sustained research effort seeking to improve the safety and conditions for people and their homes and other low-rise buildings in the tropics. Tourism is an important component of northern Australian economy and the identification of the backpacker market in Australia by Professor Philip Pearce and Associate Professor Laurie Murphy and the incorporation of these findings into policy and tourism promotion strategies has supported the growth of backpacker tourism in northern Queensland and Australia. The health and wellbeing of people in the tropics have been improved through the research into chronic middle ear infections and empowerment of Indigenous communities. The carbon farming example points to an exciting new industry in the tropics - sustainable carbon.

The research impacts demonstrate that JCU's contribution far exceeds its economic and human capital contribution. Research capacity in Northern Australia provides a flexible capability that can address some of the most significant challenges and issues that confront the region. This research capacity itself provides a vital part of the infrastructure to sustain the environment, economies and population of tropical Australia.

5.4 JAMES COOK UNIVERSITY OVERALL IMPACT

The effects of a regional university such as James Cook University upon its region, nationally and internationally, are wide and varied. This report quantifies JCU's economic impact and its contribution to human capital. The findings of these analyses demonstrate that the University makes a significant contribution to the regional economy of northern Queensland. At the economic level, by employing over 2,000 FTE staff and teaching over 12,000 FTE students the effects on the region are profound. However, the economic impact of JCU is far greater than its annual expenditure in its operations and expenditure of staff and students. Arguably its greatest contribution is to human capital which provides a very large and substantial boost to the economy and wellbeing of Queensland. Universities are crucial in developing human capital, especially in regional areas. The presence of graduates in a region demonstrably contributes higher wages and lower unemployment rates, and provides a more educated and productive workforce. Ultimately, this contribution to human capital is an important catalyst for growth, economic activity and wellbeing in regional areas.

The research impact case studies reveal another dimension of the effects a university has on its region. JCU's Tropical strategy is perfectly aligned to its regional location. The research impact case studies demonstrate how a university can affect its region beyond the demonstrable economic and human capital impacts. Universities, with their inherent research capacity, investigate and provide evidence to improve health outcomes (Ear Trial and Empowerment Research Program), safety (Cyclone Testing Station), economic development (Backpacker Tourism) and environment (Carbon Farming).

JAMES COOK UNIVERSITY

Research at JCU contributes a substantial and very flexible capacity to address some of the most significant and challenging issues that confront the region. It is a very important regional capacity provided by the University that has international effects. JCU is the most critical piece of research infrastructure in northern Australia. Through its research capacity, JCU connects northern Australia into the international networks of expertise in disciplines as widespread as health, ecology and human sciences. JCU contributes to the international stock of knowledge and in turn draws that knowledge to Tropical Australia.

The impact of JCU on the regional economies, the contribution of graduates to the stock of human capital, coupled with the impact of its research demonstrates that JCU plays a vital role in the economy of northern Queensland and to Gross State Product in Queensland. In addition, JCU's contribution to the production of human capital has sustained impacts on the region. Through research impacts, its graduates, its own expenditure and the human capital it produces JCU creates a pipeline of capital supporting the region, its economic development and sustainability into the future.

APPENDIX 1: INPUT-OUTPUT ANALYSIS

In this project the Western Research Institute (WRI) has used SIRE analysis to estimate the economic impact of JCU on the economies of Cairns LGA, Townsville LGA and Queensland.

The impacts are measured in terms of industry value added, Gross Regional Product, household income and full-time equivalent jobs. All impacts are measured in either dollar terms or Full-Time Equivalent employment terms and as a percentage of the regional economy.

Inter-industry models can be used for economic impact analysis, to estimate the benefits or costs generated by new initiatives on each and every sector of an economy. For example, if there is a change in the purchasing or sales pattern of any industry, the flow-on or multiplier effects on upstream industries can be calculated. Further details about SIRE analysis are provided at the conclusion of this Appendix.

Constructing the Tables

The table for this project has been constructed using the GRIT technique developed by Professor Guy West and Professor Rod Jensen of the University of Queensland. The GRIT technique, which uses both national Australian Bureau of Statistics data and local superior data concerning the industry in question, is the most reputable method of input-output table construction in Australia and indeed the world.

GRIT uses a series of non-survey steps to produce a prototype regional table from the national table, but provides the opportunity at various stages for the insertion of superior data. The system is "variable interference" in that the analyst is able to determine the extent to which they interfere with the mechanical processes by introducing primary or other superior data.

The GRIT system is designed to produce regional tables that are:

- Consistent in accounting terms with each other and with the national table;
- Capable of calculations to a reasonable degree of wholistic accuracy; and
- Capable of being updated with minimum effort as new data becomes available.

The GRIT technique is basically a hybrid method of deriving state and regional input-output tables from the national input-output table while at the same time allowing for the insertion of superior data at various stages in the construction of the tables.

The use of SIRE analysis in the tables will result in a more accurate estimate of the significance of JCU than would be possible with traditional input-output analysis.

Simulating Impacts on Regional Economies: The SIRE Model

Economic modelling at the regional and small area level is restricted by model and data availability. Often, resource and time limitations preclude the construction of complex models such as computable general equilibrium (CGE) models, and in fact there are arguments to suggest that building a CGE model for a small region, while not invalid, may not be a very efficient use of resources in the context of the trade-off between increased complexity and increased data 'fuzziness'.

Input-output modelling is usually used in such cases since it really provides the only practical option to planners. The assumptions of the input-output model are concerned almost entirely with the nature of production. Inter-industry models are based on the premise that it is possible to divide all productive activities in an economy into sectors or industries whose inter-

relations can be meaningfully expressed as a set of equations. The crucial assumption in the input-output model[18] is that the money value of goods and services delivered by an industry to other producing sectors is a linear and homogeneous function of the output level of the purchasing industry with supply being infinitely elastic.

This linearity assumption clearly lays simple I-O models open to valid criticism. It implies a strict proportional relationship between input coefficients and output; for example, income coefficients are average propensities and employment coefficients reflect average labor productivity rates. In impact studies, this property can lead to an overestimation of the flow-on (multiplier) effects, particularly if the initial impacts are relatively modest. For example, many industries can increase output in the short term without corresponding proportional increases in wage costs and employment, particularly if there is slack capacity.

In the following section, a more general structural form of a model for simulating impacts on regional economies (SIRE) is suggested which provides for non-linearities in production in both primary and intermediate inputs.

The SIRE model shares much of the structure of the conventional input-output model. Total inputs are equal to intermediate inputs plus primary inputs (labour and capital). In the conventional input-output model, the inputs purchased by each sector are a function only of the level of output of that sector. The input function is assumed linear and homogeneous of degree one, which implies constant returns to scale and no substitution between inputs.

The SIRE model departs here from the conventional input-output model by a number of steps that a) replace sets of average propensities with corresponding marginal propensities (elasticities) within the model's major linkages, and b) provide for changes in intermediate input coefficients as a function of relative price changes. There is room for variation between models and applications in the implementation and specifications of these linkages.

Primary Inputs

The first step is to allow for non-constant returns to scale and substitution between primary input factors. Value added at factor cost is calculated based on marginal changes in output by industry. The value added elasticities are estimated econometrically for industry using time-series data assuming a long-run equilibrium relationship between real value added at factor cost and total production.

The shares of wage (compensation of employees) and non-wage (gross operating surplus and mixed income) contributions to factor costs are assumed to be based on the same long-run relationship as that for total value added. The change in wage cost is then calculated from the marginal change in the share of wage costs in total factor costs. Gross operating surplus plus mixed income is calculated as the residual. The change in employment is calculated based on the average wage rate in each industry times the change in wages.

Household Consumption Expenditure

In a similar manner to primary inputs, total household consumption expenditure is assumed to follow a long-run equilibrium relationship between real consumption and income. Ideally, consumption expenditure should be a function of disposable income and the function should also include variables such as wealth, etc. In this simplified version of the model, income is taken as wage income.

To ensure consistency between the long-run and short-run relationships, the constraint should be satisfied which gives a long-run elasticity equal to unity. The estimated short-run elasticity of consumption with respect to wage income is 0.926. Individual commodity expenditures are expressed in terms of total expenditure and are assumed to be based on the same long-run relationship as that for total expenditure.

18 Input-output is a special case of inter-industry analysis. Inter-industry economics encompasses any methodology which takes into account the interdependence among the productive units of the economy. Input-output is only one of several methods for analysing these interdependencies.

The budget shares for each commodity should remain constant in the long-run but that short-term fluctuations are possible as income changes. Industry sourced non-wage household income is included in the other value added component of primary inputs.

Intermediate Inputs

Intermediate input coefficients can vary because of substitution effects caused by relative price changes, or through changes in technology. Technology change is generally regarded as a long run phenomenon. Hence, in short run impact situations, price effects will be the major source of change.

The regional technology coefficient is the sum of the regional purchase coefficient and the regional import coefficient and industry output prices are a weighted average of industry local and import prices. Note that the regional direct requirements coefficients can change, even when industry technology is fixed, as a result of relative price changes.

Import Substitution

The price model can also be used to adjust the regional purchase coefficients by calculating the substitution effect between locally produced and imported purchases. In most impact situations at the regional level, it can be assumed that changes in local production will have no or negligible effect on import prices. The Trade Weighted Index provides the base level differential between the local and import price levels. In addition, when adjusting the regional purchase coefficients, a penalty function is applied as a surrogate for capacity limitations in the case where the local price decreases relative to the import price thus resulting in increased demand for the local product.

Model Solution

The structural equations in this type of model cannot be solved analytically, because the input coefficients vary with the endogenous variables and thus also become endogenous. Hence, the solution procedure requires the use of an iterative recursive algorithm, such as the Gauss-Seidel method.

The operational performance of the model, compared to the conventional input-output model, is determined in part by the productivity gains, both labour and capital, experienced by industries as they expand. This results in reduced unit factor costs and local product prices. If import prices are assumed to be unaffected by local production, then the reduction in local prices relative to import prices will see a shift towards locally produced inputs, thus further stimulating local production. The extent of these additional flow-on effects will not only depend on the relative shifts in local and import prices, but also the elasticity of substitution between local and imported inputs.

This has implications for the results of this type of model, particularly if compared with those from the conventional input-output model. If price effects are ignored, then we would expect that, while the output multipliers and impacts may not be significantly different, income and employment impacts should be smaller because of the marginal coefficients associated with labour productivity. This is because many industries, especially those that are more capital intensive and can implement further productivity gains, can increase output, particularly in the short run, without corresponding proportional increases in employment and hence income payments. However, when price effects are incorporated into the model, the direction of change becomes less clear, since these can potentially generate compounding or offsetting changes. If the import substitution elasticities are inelastic, then this will reinforce the downward effects on multipliers, but if the elasticities are large (elastic) then the price effects offset the productivity gains and the multipliers and impacts could exceed those from the conventional input-output model.

Note: In calculating JCU's economic impact and human capital contribution it should be noted that the Australian Bureau of Statistics applies a confidentiality technique to its census data tables. The technique involves small random adjustments to the data which help prevent the disclosure of any identifiable data[19].

19 For further information about the confidentiality technique adopted by the Australian Bureau of Statistics please refer to the following web address: http://www.abs.gov.au/websitedbs/censushome.nsf/home/factsheetsccd?opendocument&navpos=450

APPENDIX 2: HUMAN CAPITAL - PUBLIC AND PRIVATE ECONOMIC VALUE

In order to estimate the public and private value of JCU education, WRI has adopted the following methodological approach.

Public and private values represented in the input-output table

1. The calculation of the public and private value that JCU graduates generate assumes, for simplicity, that all graduates are employed in the state of Queensland.

2. The premise is that total gross operating surplus (GOS) in the Queensland 2011-2012 input-output table represents the public value attributed to firms in the economy, while total compensation of employees (COE) in the input-output table represents the private value attributed to individuals.

3. The total value added in the Queensland input-output table is the sum of GOS plus COE. There is a relationship between public, private and total values, whereby the total value represents the sum of the public and private values. This relationship can be used to calculate the ratio of private value to total value in Queensland.

4. For the purpose of this model, it is assumed that the relationships between current value added, GOS and COE (specifically the COE/value added ratio) will persist in the future, for 43 years (the period of time over which it is assumed that the JCU graduates are employed), and importantly will apply to all firms and employees in Queensland.

Graduate earnings

1. A proportion of the COE in the Queensland 2011-2012 input-output table is earned by students who graduated from JCU in 2011, becoming employees on graduation.

2. Students, upon graduation, will have higher salaries and COE (than those without a degree), but will also increase GOS of the firms (otherwise, the firms will not be willing to employ students). In other words, it is assumed that the productivity of the firms will be shared in some proportion between labour (employees) and capital (the owners of the firms).

3. The COE that JCU generates has been calculated through an analysis of Australian Bureau of Statistics personal income data by age, qualification and field of education for the state of Queensland. The present value of lifetime earnings has been calculated using this data and this represents the private value of JCU education, specifically:

    a. The present value of undergraduate degrees over and above that realised for people without university qualifications; and

    b. The present value of postgraduate degrees over and above that realised for people with an undergraduate degree.

Applying the present value of graduate earnings to the ratios from the input-output table

1. The COE/value added ratio, derived from the input-output table for Queensland in 2011-2012, can be applied to the JCU context in order to estimate the public, private and total values of human capital generated by JCU. Specifically, the present value of lifetime earnings for JCU graduates was multiplied by the COE/value added ratio, resulting in an estimate of the total value of human capital that JCU generates.

2. The difference between the total value that JCU generates and the present value of lifetime earnings of JCU students represents the public value of JCU education.

Both public and private values of JCU degrees represent the additional value produced by holders of JCU postgraduate degrees above what they would have produced if they had undergraduate degrees, and by holders of JCU undergraduate degrees above what they would have produced if they had no university degree.

The calculated public value of a JCU degree includes that value attributable to the capital and owners of businesses, but does not include intangible benefits such as cultural, health and other community benefits.

Note: In calculating JCU's economic impact and human capital contribution it should be noted that the Australian Bureau of Statistics applies a confidentiality technique to its census data tables. The technique involves small random adjustments to the data which help prevent the disclosure of any identifiable data[20].

20 For further information about the confidentiality technique adopted by the Australian Bureau of Statistics please refer to the following web address: http://www.abs.gov.au/websitedbs/censushome.nsf/home/factsheetsccd?opendocument&navpos=450

APPENDIX 3: GLOSSARY OF TERMS

Capital Expenditure	Gross fixed capital expenditure is the purchase of durable investment goods such as dwellings, plant and equipment. JCU provided information on capital expenditure for each LGA and elsewhere in QLD.
COE	Compensation of Employees (COE) is equal to the wages and salaries of employees plus on-costs (e.g. superannuation and payroll tax). Compensation of Employees is the basis of the Household Income multiplier.
Employment	Employment is measured as full-time equivalent (FTE) jobs.
Exports	At the national level exports are goods and services sold to non-residents. Note that non-residents are defined as consumers, firms and governments from outside a given area. To illustrate the difference, the sale of education fees from the Albury campus of Charles Sturt University to a purchaser elsewhere in Murray statistical division is an export with respect to the Albury LGA input-output table, but is not classified as an export in the Murray / Ovens-Murray input-output table.
Final Consumption	Final consumption expenditure includes the current expenditure of households, industry and government. It includes purchases of durable and non-durable commodities, except the purchase of dwellings and equipment that are capital in nature. There are two types of final consumption: private final consumption expenditure (PFCE) and government final consumption expenditure (GFCE).
Final Demand	Final demand is the demand for goods and services not used up during the production process. Final demand is the sum of household and government consumption expenditure, capital investment, exports and increases in inventories.
Flow-on	The value of changes in the regional economy in the course of additional round of spending after the initial expenditure by JCU was made.
Full time equivalent employment	A measure of workload of employed person in a given location that makes workloads comparable across different types of employment (part-time, full time and casual). In this report, FTE employment is calculated as 1.0 x the number of full-time workers + 0.5 x the number of part-time workers.
Graduation expenditure	Derived expenditure by non-local guests of graduates attending ceremonies at each campus.
Household income	Measures the benefit received by regional households from economic activity. It typically refers to compensation of employees but can also include income in return for productive activity such as, the gross mixed income of unincorporated enterprises, gross operating surplus on dwellings owned by the person, and property income receivable and transfers receivable such as social assistance benefits and non-life insurance claims.
Initial Impact	The value of the immediate changes in the regional economy of Cairns and Townsville as a result of increased expenditure by JCU.

Intermediate Inputs	An intermediate input is a good or service that is used in the production process.
Imports	Imports are goods and services purchased from non-residents and may include: competing imports, where there is a domestically produced substitute; and complementary imports, where there is no domestically produced substitute. Note that non-residents are defined as consumers, firms and governments from outside a given area. To illustrate the difference, a purchase of computing equipment from Orange LGA by the Bathurst campus of Charles Sturt University is an import with respect to the Bathurst input-output table, but is not classified as an import in the input-output table for the Central West statistical division.
GOS	Gross Operating Surplus (GOS) is the excess of gross output over the costs of production, before deducting depreciation, interest and company taxes.
Multiplier	A multiplier is a summary measure used for estimating the economic impact on an economy caused by a change in the demand for the output of a particular industry or group of industries. A multiplier indicates the relative magnitude of the flow-on effects of James Cook University compared to the direct effect of the University. The multipliers in this report are for output, value added, household income (i.e. compensation of employees) and employment.
Output	Output is equal to total sales (i.e. quantity sold multiplied by price per unit).
Primary Inputs	A primary input is an input into the production process that is not a good or service. Examples of primary inputs are compensation of employees, gross operating surplus, imports and indirect taxes on products and production.
Student expenditure	Derived expenditure by students from the Cairns and Townsville campuses.
Value Added	Value-added is equal to the value of output minus the value of intermediate inputs. That is, value added is the difference between the costs of production (excluding the Compensation of Employees, Gross Operating Surplus, Taxes and Imports) and the value of sales turnover. In a national accounts context, Gross Domestic Product (GDP) consists of the sum of value-added by all industries. Value-added also pertains to differences between the value of production at various stages of the supply chain.
University's operations	CU provided WRI with detailed information about the University's operating expenditure and income, including staff wages, salaries and the number of Full-Time Equivalent employees, along with the location of this expenditure and income.

APPENDIX 4: RESULT TABLES

SUMMARY TABLES FOR 2011

Impacts on the Queensland economy - 2011

QLD Economy	FTE (Thousands)	Household Income (Millions)	GSP (Millions)
Queensland	2,001.41	136,400.02	291,470.92
JCU as a proportion of the QLD Economy			
JCU Operations	0.16%	0.17%	0.13%
Capital Expenditure	0.02%	0.02%	0.02%
Student Expenditure	0.03%	0.03%	0.03%
Total Impact	0.22%	0.23%	0.18%

Note: the sum of data in this table may not equal total impacts due to rounding and the inclusion of graduation visitation impacts.

Impacts on the economy of Cairns LGA - 2011

Cairns LGA Economy	FTE (Thousands)	Household Income (Millions)	GRP (Millions)
Cairns	53.06	3,384.16	7,846.34
JCU as a proportion of the Cairns LGA Economy			
JCU Operations	1.18%	1.41%	0.84%
Capital Expenditure	0.39%	0.35%	0.33%
Student Expenditure	0.37%	0.33%	0.35%
Total Impact	1.94%	2.09%	1.53%

Note: the sum of data in this table may not equal total impacts due to rounding and the inclusion of graduation visitation impacts.

Impacts on the economy of Townsville LGA - 2011

Townsville LGA Economy	FTE (Thousands)	Household Income (Millions)	GRP (Millions)
Townsville	59.93	4,089.09	8,983.16
JCU as a proportion of the Townsville LGA Economy			
JCU Operations	3.62%	3.99%	2.92%
Capital Expenditure	0.27%	0.27%	0.24%
Student Expenditure	0.81%	0.71%	0.76%
Total Impact	4.71%	4.97%	3.92%

Note: the sum of data in this table may not equal total impacts due to rounding and the inclusion of graduation visitation impacts.

DETAIL TABLES

Table 1: Distribution of economic impacts by Industry Sector – Queensland 2011

	Industry Value Added			Household Income			FTE Employment		
	$m	% of total impact	% of total in QLD	$m	% of total impact	% of total in QLD	No.	% of total impact	% of total in QLD
Agriculture	3.8	0.7%	0.1%	0.8	0.3%	0.1%	35	0.8%	0.1%
Coal mining	2.4	0.4%	0.0%	0.7	0.2%	0.0%	5	0.1%	0.0%
Other mining	1.0	0.2%	0.0%	0.3	0.1%	0.0%	3	0.1%	0.0%
Food & beverage Manufacturing	5.8	1.1%	0.1%	3.1	1.0%	0.1%	52	1.2%	0.1%
Textile Manufacturing	0.6	0.1%	0.2%	0.4	0.1%	0.2%	8	0.2%	0.2%
Wood product Manufacturing	0.6	0.1%	0.1%	0.4	0.1%	0.1%	6	0.1%	0.1%
Paper product Manufacturing	0.7	0.1%	0.2%	0.4	0.1%	0.2%	5	0.1%	0.2%
Printing	0.4	0.1%	0.1%	0.2	0.1%	0.1%	4	0.1%	0.1%
Chemical product Manufacturing	1.9	0.3%	0.1%	1.0	0.3%	0.1%	12	0.3%	0.1%
Non-metallic mineral	1.0	0.2%	0.1%	0.5	0.2%	0.1%	7	0.2%	0.1%
Primary metal product Manufacturing	1.3	0.2%	0.0%	0.8	0.3%	0.0%	8	0.2%	0.0%
Fab metal product Manufacturing	0.9	0.2%	0.1%	0.5	0.2%	0.1%	9	0.2%	0.1%
Transport equip Manufacturing	1.3	0.2%	0.1%	0.8	0.3%	0.1%	12	0.3%	0.1%
Machinery & equipment Manufacturing	3.0	0.6%	0.1%	1.9	0.6%	0.1%	26	0.6%	0.1%
Other Manufacturing	3.4	0.6%	0.6%	2.1	0.7%	0.6%	45	1.0%	0.6%
Utilities	8.9	1.6%	0.1%	2.9	0.9%	0.1%	49	1.1%	0.1%
Construction	15.8	2.9%	0.1%	7.7	2.5%	0.1%	138	3.2%	0.1%
Wholesale	16.2	3.0%	0.1%	11.4	3.7%	0.1%	73	1.7%	0.1%
Retail	28.4	5.3%	0.2%	18.5	6.0%	0.2%	374	8.6%	0.2%
Hospitality	12.8	2.4%	0.2%	9.0	2.9%	0.2%	214	4.9%	0.2%
Transport & storage	21.6	4.0%	0.1%	10.2	3.3%	0.1%	156	3.6%	0.1%
Communications	8.3	1.5%	0.1%	3.1	1.0%	0.1%	41	0.9%	0.1%
Finance & Insurance Services	21.7	4.0%	0.1%	8.8	2.9%	0.1%	69	1.6%	0.1%
Real Estate & Rental Services	5.2	1.0%	0.1%	1.8	0.6%	0.1%	32	0.7%	0.1%
Own dwellings	51.9	9.6%	0.2%	0.0	0.0%	0.0%	0	0.0%	0.0%
Professional & Scientific Services	13.5	2.5%	0.1%	8.3	2.7%	0.1%	112	2.6%	0.1%
Administrative Services	5.4	1.0%	0.1%	4.4	1.4%	0.1%	59	1.4%	0.1%
Public Administration and Defence	6.4	1.2%	0.0%	4.9	1.6%	0.0%	62	1.4%	0.0%
JCU	255.7	47.4%	100.0%	172.7	56.1%	100.0%	2176	50.2%	100.0%
Education	11.1	2.1%	0.1%	9.3	3.0%	0.1%	135	3.1%	0.1%
Health & Community Services	16.5	3.1%	0.1%	13.8	4.5%	0.1%	205	4.7%	0.1%
Arts & Recreation Services	4.7	0.9%	0.3%	2.3	0.8%	0.3%	89	2.0%	0.3%
Personal & Other Services	7.0	1.3%	0.1%	4.8	1.6%	0.1%	112	2.6%	0.1%
Total	538.9	100%	0.2%	307.8	100%	0.2%	4,331	100%	0.2%

Note: Due to rounding, data may not sum to the totals presented in this table.

Table 2: Distribution of economic impacts by Industry Sector – Cairns 2011

	Industry Value Added			Household Income			FTE Employment		
	$m	% of total impact	% of total in QLD	$m	% of total impact	% of total in QLD	No.	% of total impact	% of total in QLD
Agriculture	0.8	0.7%	0.8%	0.2	0.2%	0.8%	6	0.6%	0.8%
Coal mining	0.0	0.0%	0.1%	0.0	0.0%	0.1%	0	0.0%	0.1%
Other mining	0.1	0.1%	0.1%	0.0	0.0%	0.1%	0	0.0%	0.1%
Food & beverage Manufacturing	1.2	1.0%	1.4%	0.5	0.8%	1.4%	10	0.9%	1.4%
Textile Manufacturing	0.1	0.1%	1.6%	0.1	0.1%	1.6%	2	0.2%	1.6%
Wood product Manufacturing	0.3	0.2%	1.4%	0.2	0.2%	1.4%	3	0.3%	1.4%
Paper product Manufacturing	0.1	0.1%	5.5%	0.0	0.1%	5.4%	1	0.1%	5.3%
Printing	0.1	0.1%	0.9%	0.1	0.1%	0.9%	1	0.1%	0.9%
Chemical product Manufacturing	0.2	0.2%	1.1%	0.1	0.1%	1.1%	1	0.1%	1.1%
Non-metallic mineral	0.4	0.3%	1.5%	0.2	0.3%	1.5%	3	0.3%	1.5%
Primary metal product Manufacturing	0.2	0.2%	0.5%	0.1	0.1%	0.5%	1	0.1%	0.5%
Fab metal product Manufacturing	0.4	0.4%	1.0%	0.2	0.3%	1.0%	4	0.4%	1.0%
Transport equip Manufacturing	0.4	0.4%	0.6%	0.3	0.4%	0.6%	3	0.3%	0.6%
Machinery & equipment Manufacturing	0.6	0.5%	1.7%	0.3	0.5%	1.7%	5	0.5%	1.7%
Other Manufacturing	2.2	1.8%	16.1%	1.2	1.6%	15.9%	28	2.7%	15.9%
Utilities	1.5	1.3%	1.1%	0.4	0.6%	1.1%	7	0.7%	1.1%
Construction	8.4	7.0%	1.8%	3.3	4.7%	1.8%	64	6.2%	1.8%
Wholesale	3.8	3.2%	1.0%	2.4	3.5%	1.0%	18	1.7%	1.0%
Retail	6.7	5.5%	1.4%	4.2	5.9%	1.4%	84	8.2%	1.4%
Hospitality	5.0	4.1%	1.3%	3.4	4.9%	1.3%	71	6.9%	1.3%
Transport & storage	6.7	5.6%	1.3%	2.9	4.1%	1.3%	48	4.7%	1.3%
Communications	1.5	1.2%	1.2%	0.5	0.7%	1.2%	7	0.7%	1.2%
Finance & Insurance Services	4.4	3.6%	1.3%	1.5	2.1%	1.3%	13	1.2%	1.3%
Real Estate & Rental Services	2.0	1.7%	0.9%	0.6	0.9%	0.9%	12	1.1%	0.9%
Own dwellings	13.6	11.3%	1.5%	0.0	0.0%	0.0%	0	0.0%	0.0%
Professional & Scientific Services	4.0	3.3%	1.1%	2.1	3.0%	1.1%	33	3.2%	1.1%
Administrative Services	1.4	1.2%	1.0%	1.1	1.6%	1.0%	15	1.5%	1.0%
Public Administration and Defence	0.7	0.5%	0.1%	0.5	0.7%	0.1%	6	0.6%	0.1%
JCU	43.3	36.0%	100.0%	36.7	51.9%	100.0%	447	43.5%	100.0%
Education	2.7	2.3%	0.7%	2.2	3.1%	0.7%	32	3.2%	0.7%
Health & Community Services	4.1	3.4%	0.7%	3.4	4.8%	0.7%	49	4.8%	0.7%
Arts & Recreation Services	1.2	1.0%	2.4%	0.5	0.8%	2.4%	21	2.1%	2.4%
Personal & Other Services	2.1	1.8%	1.4%	1.4	2.0%	1.4%	33	3.2%	1.4%
Total	120.1	100%	1.8%	70.7	100%	2.1%	1,027	100%	1.9%

Note: Due to rounding, data may not sum to the totals presented in this table.

Table 3: Distribution of economic impacts by Industry Sector – Townsville 2011

	Industry Value Added			Household Income			FTE Employment		
	$m	% of total impact	% of total in QLD	$m	% of total impact	% of total in QLD	No.	% of total impact	% of total in QLD
Agriculture	0.6	0.2%	1.7%	0.1	0.1%	1.7%	5	0.2%	1.7%
Coal mining	0.1	0.0%	0.4%	0.0	0.0%	0.4%	0	0.0%	0.4%
Other mining	0.5	0.1%	0.3%	0.1	0.1%	0.3%	1	0.0%	0.3%
Food & beverage Manufacturing	3.1	0.9%	3.2%	1.6	0.8%	3.2%	27	1.0%	3.2%
Textile Manufacturing	0.4	0.1%	3.4%	0.2	0.1%	3.4%	5	0.2%	3.4%
Wood product Manufacturing	0.2	0.1%	1.1%	0.1	0.1%	1.1%	2	0.1%	1.1%
Paper product Manufacturing	0.5	0.1%	4.8%	0.2	0.1%	4.8%	3	0.1%	4.7%
Printing	0.1	0.0%	1.5%	0.1	0.0%	1.5%	1	0.0%	1.5%
Chemical product Manufacturing	1.2	0.3%	1.9%	0.6	0.3%	1.8%	8	0.3%	1.9%
Non-metallic mineral	0.6	0.2%	1.4%	0.3	0.1%	1.4%	4	0.2%	1.4%
Primary metal product Manufacturing	1.4	0.4%	0.5%	0.9	0.5%	0.5%	9	0.3%	0.5%
Fab metal product Manufacturing	0.5	0.1%	1.0%	0.3	0.2%	1.0%	6	0.2%	1.0%
Transport equip Manufacturing	0.7	0.2%	1.4%	0.4	0.2%	1.4%	6	0.2%	1.4%
Machinery & equipment Manufacturing	1.9	0.6%	4.0%	1.3	0.7%	4.0%	18	0.6%	4.0%
Other Manufacturing	1.0	0.3%	9.9%	0.6	0.3%	9.9%	13	0.5%	9.9%
Utilities	4.8	1.4%	2.1%	1.6	0.8%	2.1%	26	0.9%	2.1%
Construction	6.3	1.8%	0.9%	2.9	1.4%	0.9%	52	1.8%	0.9%
Wholesale	8.8	2.5%	2.2%	6.1	3.0%	2.2%	39	1.4%	2.2%
Retail	17.5	5.0%	3.7%	11.0	5.4%	3.7%	225	8.0%	3.7%
Hospitality	8.1	2.3%	3.3%	5.2	2.6%	3.3%	134	4.7%	3.3%
Transport & storage	15.2	4.3%	3.0%	7.2	3.5%	3.0%	106	3.8%	3.0%
Communications	5.7	1.6%	2.7%	1.9	1.0%	2.7%	27	1.0%	2.7%
Finance & Insurance Services	11.4	3.2%	2.7%	4.1	2.0%	2.7%	34	1.2%	2.7%
Real Estate & Rental Services	3.0	0.8%	1.5%	1.0	0.5%	1.5%	18	0.6%	1.5%
Own dwellings	34.4	9.8%	3.5%	0.0	0.0%	0.0%	0	0.0%	0.0%
Professional & Scientific Services	6.5	1.8%	1.6%	3.7	1.8%	1.6%	53	1.9%	1.6%
Administrative Services	2.7	0.8%	1.6%	2.2	1.1%	1.6%	29	1.0%	1.6%
Public Administration and Defence	1.9	0.5%	0.2%	1.4	0.7%	0.2%	18	0.6%	0.2%
JCU	186.9	53.1%	100.0%	126.5	62.2%	100.0%	1588	56.3%	100.0%
Education	8.3	2.3%	1.8%	7.7	3.8%	2.0%	111	3.9%	2.1%
Health & Community Services	11.5	3.3%	1.8%	9.6	4.7%	1.8%	137	4.9%	1.8%
Arts & Recreation Services	3.1	0.9%	6.2%	1.5	0.8%	6.2%	58	2.1%	6.2%
Personal & Other Services	3.6	1.0%	4.0%	2.5	1.2%	4.0%	57	2.0%	4.0%
Total	352.3	100%	4.5%	203.2	100%	5.0%	2,820	100%	4.7%

Note: Due to rounding, data may not sum to the totals presented in this table.

SUMMARY TABLES FOR 2012

Impacts on the Queensland economy – 2012

Queensland Economy	FTE (Thousands)	Household Income (Millions)	GSP (Millions)
Queensland	2,001.41	136,400.02	291,470.92
JCU as a proportion of the QLD Economy			
JCU Operations	0.18%	0.20%	0.14%
Capital Expenditure	0.03%	0.03%	0.03%
Student Expenditure	0.03%	0.03%	0.03%
Total Impact	0.24%	0.26%	0.20%

Note: the sum of data in this table may not equal total impacts due to rounding and the inclusion of graduation visitation impacts.

Impacts on the economy of Cairns LGA – 2012

Cairns LGA Economy	FTE (Thousands)	Household Income (Millions)	GRP (Millions)
Cairns	53.06	3,384.16	7,846.34
JCU as a proportion of the Cairns LGA Economy			
JCU Operations	1.36%	1.65%	1.01%
Capital Expenditure	0.42%	0.38%	0.37%
Student Expenditure	0.39%	0.35%	0.37%
Total Impact	2.16%	2.38%	1.75%

Note: the sum of data in this table may not equal total impacts due to rounding and the inclusion of graduation visitation impacts.

Impacts on the economy of Townsville LGA - 2012

Townsville LGA Economy	FTE (Thousands)	Household Income (Millions)	GRP (Millions)
Townsville	59.93	4,089.09	8,983.16
JCU as a proportion of the Townsville LGA Economy			
JCU Operations	3.99%	4.47%	3.30%
Capital Expenditure	0.45%	0.43%	0.38%
Student Expenditure	0.79%	0.69%	0.74%
Total Impact	5.24%	5.60%	4.43%

Note: the sum of data in this table may not equal total impacts due to rounding and the inclusion of graduation visitation impacts.

Table 4: Distribution of economic impacts by Industry Sector – Queensland 2012

	Industry Value Added			Household Income			FTE Employment		
	$m	% of total impact	% of total in QLD	$m	% of total impact	% of total in QLD	No.	% of total impact	% of total in QLD
Agriculture	4.4	0.8%	0.1%	1.0	0.3%	0.1%	41	0.8%	0.1%
Coal mining	3.0	0.5%	0.0%	0.8	0.2%	0.0%	6	0.1%	0.0%
Other mining	1.3	0.2%	0.0%	0.4	0.1%	0.0%	4	0.1%	0.0%
Food & beverage Manufacturing	6.2	1.1%	0.1%	3.3	0.9%	0.1%	56	1.2%	0.1%
Textile Manufacturing	0.7	0.1%	0.2%	0.4	0.1%	0.2%	8	0.2%	0.2%
Wood product Manufacturing	0.9	0.1%	0.1%	0.5	0.1%	0.1%	9	0.2%	0.1%
Paper product Manufacturing	0.7	0.1%	0.2%	0.4	0.1%	0.2%	5	0.1%	0.2%
Printing	0.4	0.1%	0.1%	0.2	0.1%	0.1%	4	0.1%	0.1%
Chemical product Manufacturing	2.2	0.4%	0.1%	1.2	0.3%	0.1%	14	0.3%	0.1%
Non-metallic mineral	1.3	0.2%	0.1%	0.7	0.2%	0.1%	10	0.2%	0.1%
Primary metal product Manufacturing	1.6	0.3%	0.1%	0.9	0.3%	0.1%	10	0.2%	0.1%
Fab metal product Manufacturing	1.1	0.2%	0.1%	0.7	0.2%	0.1%	11	0.2%	0.1%
Transport equip Manufacturing	1.5	0.3%	0.1%	0.9	0.3%	0.1%	13	0.3%	0.1%
Machinery & equipment Manufacturing	3.2	0.5%	0.1%	2.0	0.6%	0.1%	28	0.6%	0.1%
Other Manufacturing	4.8	0.8%	0.8%	2.9	0.8%	0.8%	63	1.3%	0.8%
Utilities	10.1	1.7%	0.1%	3.3	0.9%	0.1%	56	1.1%	0.1%
Construction	23.8	4.1%	0.1%	11.7	3.3%	0.1%	209	4.3%	0.1%
Wholesale	18.1	3.1%	0.1%	12.8	3.7%	0.1%	82	1.7%	0.1%
Retail	32.4	5.5%	0.2%	21.2	6.0%	0.2%	428	8.8%	0.2%
Hospitality	14.4	2.5%	0.2%	10.1	2.9%	0.2%	242	5.0%	0.2%
Transport & storage	23.4	4.0%	0.1%	11.1	3.2%	0.1%	169	3.5%	0.1%
Communications	9.4	1.6%	0.2%	3.5	1.0%	0.2%	46	0.9%	0.2%
Finance & Insurance Services	24.9	4.2%	0.1%	10.1	2.9%	0.1%	80	1.6%	0.1%
Real Estate & Rental Services	5.9	1.0%	0.1%	2.1	0.6%	0.1%	37	0.8%	0.1%
Own dwellings	56.6	9.6%	0.2%	0.0	0.0%	0.0%	0	0.0%	0.0%
Professional & Scientific Services	14.4	2.4%	0.1%	8.8	2.5%	0.1%	119	2.4%	0.1%
Administrative Services	6.2	1.1%	0.1%	5.1	1.4%	0.1%	67	1.4%	0.1%
Public Administration and Defence	7.9	1.3%	0.1%	6.0	1.7%	0.1%	77	1.6%	0.1%
JCU	263.1	44.8%	100.0%	194.6	55.5%	100.0%	2375	48.8%	1.7%
Education	12.6	2.1%	0.1%	10.5	3.0%	0.1%	153	3.1%	0.1%
Health & Community Services	18.3	3.1%	0.1%	15.3	4.4%	0.1%	227	4.7%	0.1%
Arts & Recreation Services	4.9	0.8%	0.3%	2.4	0.7%	0.3%	92	1.9%	0.3%
Personal & Other Services	7.6	1.3%	0.2%	5.2	1.5%	0.2%	122	2.5%	0.2%
Total	587.1	100%	0.2%	350.3	100%	0.3%	4,862	100%	0.2%

Note: Due to rounding, data may not sum to the totals presented in this table.

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Table 5: Distribution of economic impacts by Industry Sector – Cairns 2012

	Industry Value Added			Household Income			FTE Employment		
	$m	% of total impact	% of total in QLD	$m	% of total impact	% of total in QLD	No.	% of total impact	% of total in QLD
Agriculture	0.8	0.6%	0.9%	0.2	0.2%	0.9%	7	0.6%	0.9%
Coal mining	0.0	0.0%	0.1%	0.0	0.0%	0.1%	0	0.0%	0.1%
Other mining	0.1	0.1%	0.2%	0.0	0.0%	0.2%	0	0.0%	0.2%
Food & beverage Manufacturing	1.3	0.9%	1.5%	0.6	0.7%	1.5%	10	0.9%	1.5%
Textile Manufacturing	0.1	0.1%	1.7%	0.1	0.1%	1.7%	2	0.2%	1.7%
Wood product Manufacturing	0.4	0.3%	1.7%	0.2	0.2%	1.7%	3	0.3%	1.7%
Paper product Manufacturing	0.1	0.1%	5.8%	0.0	0.1%	5.7%	1	0.1%	5.7%
Printing	0.1	0.1%	0.9%	0.1	0.1%	0.9%	1	0.1%	0.9%
Chemical product Manufacturing	0.2	0.2%	1.3%	0.1	0.1%	1.3%	1	0.1%	1.3%
Non-metallic mineral	0.5	0.4%	1.9%	0.2	0.3%	1.9%	4	0.3%	1.9%
Primary metal product Manufacturing	0.2	0.2%	0.5%	0.1	0.1%	0.5%	1	0.1%	0.5%
Fab metal product Manufacturing	0.5	0.4%	1.2%	0.3	0.3%	1.2%	5	0.4%	1.2%
Transport equip Manufacturing	0.5	0.4%	0.6%	0.3	0.4%	0.6%	4	0.3%	0.6%
Machinery & equipment Manufacturing	0.4	0.3%	1.0%	0.2	0.2%	1.0%	3	0.3%	1.0%
Other Manufacturing	1.7	1.2%	12.5%	0.9	1.1%	12.4%	22	1.9%	12.4%
Utilities	1.6	1.2%	1.2%	0.4	0.5%	1.2%	8	0.7%	1.2%
Construction	11.2	8.1%	2.4%	4.5	5.6%	2.4%	86	7.5%	2.4%
Wholesale	4.1	3.0%	1.0%	2.6	3.2%	1.0%	19	1.6%	1.0%
Retail	7.5	5.5%	1.5%	4.7	5.9%	1.5%	95	8.3%	1.5%
Hospitality	5.8	4.2%	1.5%	4.0	5.0%	1.5%	83	7.2%	1.5%
Transport & storage	7.4	5.4%	1.4%	3.2	4.0%	1.4%	53	4.6%	1.4%
Communications	1.7	1.2%	1.4%	0.6	0.7%	1.4%	8	0.7%	1.4%
Finance & Insurance Services	4.9	3.6%	1.4%	1.7	2.1%	1.4%	15	1.3%	1.4%
Real Estate & Rental Services	2.3	1.6%	1.0%	0.7	0.9%	1.0%	13	1.2%	1.0%
Own dwellings	15.0	10.9%	1.7%	0.0	0.0%	0.0%	0	0.0%	0.0%
Professional & Scientific Services	3.5	2.5%	0.9%	1.9	2.3%	0.9%	29	2.5%	0.9%
Administrative Services	1.6	1.2%	1.1%	1.3	1.6%	1.1%	18	1.5%	1.1%
Public Administration and Defence	0.7	0.5%	0.1%	0.5	0.7%	0.1%	7	0.6%	0.1%
JCU	52.0	37.8%	100.0%	42.8	53.1%	100.0%	502	43.7%	100.0%
Education	3.1	2.3%	0.8%	2.6	3.2%	0.8%	38	3.3%	0.8%
Health & Community Services	4.6	3.3%	0.7%	3.8	4.7%	0.7%	55	4.8%	0.7%
Arts & Recreation Services	1.2	0.9%	2.5%	0.6	0.7%	2.5%	22	2.0%	2.5%
Personal & Other Services	2.3	1.7%	1.5%	1.5	1.9%	1.5%	36	3.2%	1.5%
Total	137.6	100%	2.0%	80.6	100%	2.4%	1,148	100%	2.2%

Note: Due to rounding, data may not sum to the totals presented in this table.

Table 6: Distribution of economic impacts by Industry Sector – Townsville 2012

	Industry Value Added			Household Income			FTE Employment		
	$m	% of total impact	% of total in QLD	$m	% of total impact	% of total in QLD	No.	% of total impact	% of total in QLD
Agriculture	0.7	0.2%	1.8%	0.1	0.1%	1.8%	6	0.2%	1.8%
Coal mining	0.1	0.0%	0.4%	0.0	0.0%	0.4%	0	0.0%	0.4%
Other mining	0.7	0.2%	0.4%	0.2	0.1%	0.4%	2	0.1%	0.4%
Food & beverage Manufacturing	3.1	0.8%	3.2%	1.6	0.7%	3.2%	28	0.9%	3.2%
Textile Manufacturing	0.4	0.1%	3.5%	0.3	0.1%	3.5%	5	0.2%	3.5%
Wood product Manufacturing	0.3	0.1%	1.7%	0.2	0.1%	1.7%	3	0.1%	1.7%
Paper product Manufacturing	0.5	0.1%	5.0%	0.2	0.1%	4.9%	3	0.1%	4.9%
Printing	0.1	0.0%	1.6%	0.1	0.0%	1.6%	1	0.0%	1.6%
Chemical product Manufacturing	1.3	0.3%	2.1%	0.7	0.3%	2.1%	9	0.3%	2.1%
Non-metallic mineral	0.8	0.2%	2.0%	0.4	0.2%	2.0%	6	0.2%	2.0%
Primary metal product Manufacturing	1.9	0.5%	0.7%	1.3	0.5%	0.7%	11	0.4%	0.7%
Fab metal product Manufacturing	0.6	0.2%	1.4%	0.4	0.2%	1.4%	7	0.2%	1.4%
Transport equip Manufacturing	0.7	0.2%	1.5%	0.5	0.2%	1.5%	6	0.2%	1.5%
Machinery & equipment Manufacturing	2.2	0.5%	4.5%	1.5	0.7%	4.4%	20	0.6%	4.5%
Other Manufacturing	2.6	0.7%	27.2%	1.7	0.7%	26.9%	36	1.1%	26.9%
Utilities	5.4	1.4%	2.4%	1.7	0.8%	2.4%	29	0.9%	2.4%
Construction	10.8	2.7%	1.6%	5.0	2.2%	1.6%	88	2.8%	1.6%
Wholesale	9.9	2.5%	2.5%	6.8	3.0%	2.5%	44	1.4%	2.5%
Retail	19.6	4.9%	4.1%	12.3	5.4%	4.1%	252	8.0%	4.1%
Hospitality	8.9	2.2%	3.7%	5.7	2.5%	3.7%	148	4.7%	3.7%
Transport & storage	16.1	4.0%	3.1%	7.6	3.3%	3.1%	113	3.6%	3.1%
Communications	6.2	1.6%	3.0%	2.1	0.9%	3.0%	30	0.9%	3.0%
Finance & Insurance Services	12.8	3.2%	3.0%	4.6	2.0%	3.0%	38	1.2%	3.0%
Real Estate & Rental Services	3.4	0.9%	1.7%	1.1	0.5%	1.7%	20	0.6%	1.7%
Own dwellings	37.0	9.3%	3.7%	0.0	0.0%	0.0%	0	0.0%	0.0%
Professional & Scientific Services	6.6	1.7%	1.7%	3.8	1.7%	1.7%	54	1.7%	1.7%
Administrative Services	3.1	0.8%	1.8%	2.5	1.1%	1.8%	33	1.1%	1.8%
Public Administration and Defence	2.1	0.5%	0.3%	1.5	0.7%	0.3%	20	0.6%	0.3%
JCU	211.3	53.1%	100.0%	141.2	61.7%	100.0%	1728	55.0%	100.0%
Education	9.3	2.3%	2.0%	8.9	3.9%	2.3%	131	4.2%	2.4%
Health & Community Services	12.6	3.2%	2.0%	10.5	4.6%	2.0%	150	4.8%	2.0%
Arts & Recreation Services	3.2	0.8%	6.3%	1.6	0.7%	6.3%	59	1.9%	6.3%
Personal & Other Services	3.7	0.9%	4.2%	2.5	1.1%	4.2%	59	1.9%	4.2%
Total	398.0	100%	5.1%	228.8	100%	5.6%	3,138	100%	5.2%

Note: Due to rounding, data may not sum to the totals presented in this table.

APPENDIX 5: CASE STUDY REFERENCES

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An economic assessment of biochar: the case for sugarcane

The following assumptions and qualifications are made:

- The application of biochar is likely to boost agricultural productivity and lead to higher yields through soil improvements, reduced nutrient run off and better water holding capacity. However, the quantitative estimates of biochar impacts on yields vary substantially, depending on the type of soil to which biochar is applied, commodity type grown and soil-plant-climate interactions [1]. For the purpose of cost analysis, it is assumed that maximum yields are achieved within three years after biochar introduction.
- Research has shown that biochar has the highest potential to boost agricultural productivity if applied to tropical soils, soils with low nutrient retention capacity and acidic soils. Therefore the cost analysis of biochar in sugarcane production was based on the research applying biochar in these soil types.[2]
- It is acknowledged that the current prices for mineral fertilisers (di-ammonium phosphate and urea) are at historically high levels and thus the cost comparison of biochar and conventional mineral fertilisers should be based on both current and historically average prices.
- The environmental and agricultural sustainability implications of biochar use are not well understood. However, there

is evidence that suggests likely usage limits due to the presence of metal contaminants in the biomass feedstock used for biochar production [3].

- The cost comparison of biochar and conventional mineral fertilisers is likely to be affected by the fact that application of the biochar will have one-off and lasting impact on the soil fertility and agricultural yields, while conventional fertilisers are applied on a regular basis.
- Due to various technical issues, biochar is not used separately as fertiliser, but rather as a supplement to conventional mineral fertilisers. Also, biochar is typically mixed with organic fertilisers (such as manure or compost) to improve its effectiveness.

Results

The comparison of biochar and mineral fertiliser costs is based on the following information:

- The prevailing prices of di-ammonium phosphate and urea ($832/t and $653/t respectively in 2011-12), average prices during 2000-2012 period ($678/t and $464/t) and historical low prices ($442 and $363).
- The recommended application rates of mineral fertilisers in sugarcane growing at the 10ha farm and in Queensland (160 kg of nitrogen/ha and 170.5 kg/ha respectively)[4]
- Conversion rates between mineral content of nitrogen and phosphorus in fertiliser and recommended application rates [5]
- Current sugarcane yields (75t/ha) and sugarcane planted area (10ha in the case of experimental trial in Mourilyan, QLD, and 326,095ha in the case of Queensland)
- A range of sugarcane prices ($232, $342 and $518, representing historical lowest, average and highest prices), yield increases (25%, 50% and 100%) and biochar prices ($37, $185, $330 per tonne of biochar-compost mix)[6], based on current literature and correspondence with Prof. Bird
- A uniform biochar application rate of 50t/ha, based on literature review
- Comparison horizon (10, 35 and 60 years) and the frequency of application of biochar and mineral fertilisers (one-off for biochar and annual for mineral fertilisers)
- Substitution rates between biochar and mineral fertilisers (no substitution, minimal substitution at 10% decline in the use of mineral fertilisers, and 25% decline in mineral fertiliser use), based on correspondence with Professor Bird.

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5. Conversion rates are based on the content of N and P in urea and di-ammonium phosphate (46% of N in urea and 18% of N and 20% of P in di-ammonium phosphate). Queensland Government. ReefWise Farming: Calculating Fertiliser Rates.

6. Representing respectively 10 times, 50% and 10% decline from current price level ($370).

Three hypothetical scenarios are modelled:

1. Optimistic, assuming high mineral fertiliser prices, high yield increases, and fast decline in biochar prices,
2. Medium, assuming historical average mineral fertiliser prices, medium yield increases and gradual decline in biochar prices, and
3. Pessimistic, assuming low average mineral fertiliser prices, low yield increases and slow decline in biochar prices.

Under the optimistic scenario, the cost of using biochar along with mineral fertilisers makes economic sense two years after the application of biochar (i.e. when the cost of biochar & mineral fertiliser mix becomes smaller than the cumulative cost of using mineral fertilisers alone).

Relative costs ratio shows by how much the cumulative costs of using biochar together with mineral fertilisers exceed the cumulative costs of using mineral fertilisers alone. Output growth ratio shows how quickly the maximum yield potential following biochar introduction is achieved. It makes economic sense if output growth ratio exceeds relative costs ratio (i.e. when incremental output gains exceed incremental cost growth). Under optimistic scenario, this will occur in year three.

TABLE 1. THE RELATIVE COSTS OF BIOCHAR

Optimistic scenario															
Year	1	2	3	4	5	6	7	8	9	10	20	35	60	75	100
Cost of biochar & mineral fertiliser combination	7,692														
Cumulative costs of mineral fertilisers	3,252	6,504	9,756	13,008	16,260	19,512	22,764	26,016	29,268	32,520	65,040	113,820	195,120	243,900	321,948
Relative costs ratio	2.37	1.68	1.46	1.34	1.27	1.23	1.20	1.17	1.15	1.14	1.07	1.04	1.02	1.02	1.01
Output growth ratio	1	1.33	1.67	2	2	2	2	2	2	2	2	2	2	2	2

Medium scenario															
Year	1	2	3	4	5	6	7	8	9	10	20	35	60	75	100
Cost of biochar & mineral fertiliser combination	24,663														
Cumulative costs of mineral fertilisers	2,463	4,925	7,388	9,850	12,313	14,775	17,238	19,700	22,163	24,625	49,250	86,188	147,750	184,688	243,788
Relative costs ratio	10.02	5.51	4.01	3.25	2.80	2.50	2.29	2.13	2.00	1.90	1.45	1.26	1.15	1.12	1.09
Output growth ratio	1	1.17	1.33	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5

Pessimistic scenario															
Year	1	2	3	4	5	6	7	8	9	10	20	35	60	75	100
Cost of biochar & mineral fertiliser combination	41,371														
Cumulative costs of mineral fertilisers	1,771	3,542	5,313	7,084	8,855	10,626	12,397	14,168	15,939	17,710	35,420	61,985	106,260	132,825	175,329
Relative costs ratio	23.36	12.18	8.45	6.59	5.47	4.73	4.19	3.80	3.48	3.24	2.12	1.64	1.37	1.30	1.23
Output growth ratio	1	1.08	1.08	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25

Under medium scenario, the cost of using biochar along with mineral fertilisers makes economic sense only after 10 years following introduction of biochar. Also, incremental output gains exceed incremental cost growth 20 years after introduction biochar.

Under pessimistic scenario, the cost of using biochar along with mineral fertilisers makes economic sense only after 20-30 years following introduction of biochar. Incremental output gains do not exceed incremental cost growth even 75 years after introduction biochar.

Overall, the costs of biochar have to decrease substantially by factors 2 to 10 to economically justify the use of this product as fertiliser.

APPENDICIES

WESTERN RESEARCH INSTITUTE

WRI is a regional development research organisation located in Bathurst, New South Wales. WRI holds a wealth of knowledge on employment, business development and investment issues affecting regional Australia. It has worked with Commonwealth, State and Local Governments and industry groups on numerous investment and development programs in regional areas. WRI has strong credentials in business and commercial market consulting and applied economic modelling including input-output analysis, shift-share, agribusiness and regional socio-economic surveys and analysis.

Dr. Andrew Johnson - Chief Executive Officer

BA(Hons I) Newcastle, PhD (UWS)

Andrew Johnson has over 20 years' experience in research leadership with a strong focus on the resources and not-for-profit spheres.

Andrew has recently held the position of Director of Research Development at the University of Newcastle (UoN), Australia. During his 12 years at UoN, Andrew achieved a number of substantial outcomes including raising in excess of $30 million in research funds to support a number of collaborative research partnerships with industry and government. He led the establishment of the Research Development office at UoN and built a team of four Research Development staff. He was Interim CEO of the CRC for Social Inclusion bid which was shortlisted in 2010. Andrew also played a key role in the highly successful energy strategy led by Research Division UoN which included a successful $30 million EIF application for the Newcastle Institute for Energy and Resources.

Andrew's skills are best suited to building capacity, sustaining collaborations, managing research programs and building networks and spheres of influence, both in the public sector and industry. Attracting new business and partnerships and ensuring their longevity by establishing appropriate governance mechanisms drives his approach to work.

Ms Danielle Ranshaw – Research Manager

BEc&Fin NSW

Danielle's experience in project management in the information technology sector combined with qualifications in economics and finance provides a solid background for WRI projects. With skills in systems design and development, Danielle has been able to extend WRI's capability in developing robust and increasingly complex systems to support research fieldwork. Additionally, Danielle has extensive experience in business process analysis, performance planning and review, report writing and project planning.

Dr. Ivan Trofimov - Research Officer

PHD (Macquarie) MEcSt (UNE) MA (Auckland)

Ivan is an economic and public policy analyst and brings experience in macroeconomics, corporate governance and international trade to WRI projects. Prior to joining WRI, he worked in corporate advisory firms, focusing on economic research and evaluation of corporate governance practices, and in a peak industry body, responsible for pharmaceutical policy formulation in Australia. He was also involved in consulting projects for the Commonwealth Secretariat, APEC Research Centre (New Zealand) and Pacific Islands Trade and Investment Commission. Ivan holds a PhD in Applied Economics from Macquarie University, and Master degrees in agricultural and development economics from the University of New England and University of Auckland. He has published several papers in international economic journals.

Ms Rebecca Hood - Research Officer

BBus (Fin/Acc) With Distinction CSU

After working in the Financial Services Industry for several years coupled with a degree in Finance and Accounting from Charles Sturt University, Rebecca brings strong skills in finance, economics, business and accounting to WRI projects. Rebecca's extensive experience in the finance field and her high level of current market knowledge gives Rebecca a solid understanding of the financial needs of regional and rural Australia. Having prior experience with local councils and retail, Rebecca also brings a robust understanding of the needs of regional businesses in our local economy to her role at WRI.

Ms Katherine Bell - Research Officer

Katherine is a freelance writer whose strengths lie in research, literature review and synthesis writing. She has over 20 years' experience in corporate communications, human resources and executive support across private, government, charitable and multi-national organisations. Katherine has a particular interest in psychology and social science. Katherine has assisted WRI in contract research work periodically over the last two years.

ASSOCIATES

Mr Tom Murphy – Associate

Tom Murphy was WRI's founding CEO and held this position from 1999 until his retirement in December 2012. Under Tom's leadership WRI completed over 300 projects for all levels of government and government departments, industry groups, businesses, financial institutions, regional development boards and community groups, and educational institutions including universities, TAFE and schools in NSW, Victoria and Queensland.

Tom previously held academic positions as senior lecturer in Economics and Director of the Regional Economics Research Unit in the Faculty of Commerce, Charles Sturt University, Bathurst and positions at the University of New England and Macquarie University. He has also held the positions of Economic Analyst with the Office of National Assessments in Canberra, with responsibility for the ASEAN economies and Senior Consultant with KPMG Peat Marwick Management Consultants.

Tom's particular expertise is in regional economics and labour markets, and he has published in a wide range of economic subject areas in refereed and non-refereed articles, books and textbooks. Tom has a high local media profile in Western NSW for economic and social commentary and also features regularly on national radio particularly in connection to the quarterly agribusiness survey conducted for Westpac Australia wide.

Dr Guy West - Associate

Dr Guy West is experienced in regional economics with specialisation in applied quantitative economics. Current research interests include the theory and application of inter-industry models particularly in an integrated spatial econometric framework, the nature of economic structure at the regional and national levels, and regional economic projection, planning and growth. This revolves primarily around the study and identification of economic structure, involving concepts such as fundamental economic structure, structural change and evolution.

Dr West has published extensively in international journals at both theoretical and empirical levels. He is an accomplished computer programmer and has developed a number of specialised economic models for analysing structural change, as well as more generalised software for inter-industry analysis. Some of this software is used extensively in universities in Australia, US, UK and Europe. He has been actively involved in consulting and advisory work in the area of economic impact analysis, planning, development and economic policy for federal, state and local government and the private sector.

Ms Dale Curran – Executive Officer

BA ANU

Dale is responsible for all administrative processes at WRI including executive support, finance, management of the Board of Directors and maintenance of policies. She has worked in a variety of roles at WRI, including Fieldwork Supervisor and Research Assistant, and has worked on several community and business surveys. In addition to her administrative role, Dale has oversight of marketing, PR and communications activities, and brings a high level of skill to the design of WRI's reports.

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