



ECONOMIC EVALUATION OF NSW COASTAL AQUACULTURE

2016

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INTRODUCTION

The University of Technology Sydney (UTS) was funded by the Fisheries Research and Development Corporation (FRDC) to undertake the Social and Economic Evaluation of NSW Coastal Aquaculture. As part of this project, UTS has commissioned the Western Research Institute (WRI) to undertake research on the economic impact of Aquaculture farming activity on NSW coastal economies.

Economic modelling undertaken by WRI utilised operational and financial data, collected from surveys with aquaculture operators (provided by ANCORS) to estimate the economic impacts of aquaculture on regional coastal economies and at the NSW State level. Modelling was undertaken for the financial year 2013/14.

The following regions were modelled:

- North Coast
- Mid North Coast
- South Coast
- NSW

The resulting economic impacts were reported in terms of output, value added, household income and full time equivalent (FTE) employment.

Results from the economic modelling showed the highest Gross Regional Product (GRP) (also known as 'value added') for the Mid North Coast region (\$25.36 m), followed by the South Coast (\$15.66m) and the North Coast (\$10.60m), with a total increase in GRP for all regions of \$51.62 million.

Household income had the highest impacts on the Mid North Coast (\$11.63m) followed by the South Coast (\$6.88m).

The greatest levels of employment were seen on the Mid North Coast (361), followed by the South Coast (182) and North Coast (143), with a total of approximately 686 FTE achieved across all regions.

ECONOMIC IMPACT OF COASTAL AQUACULTURE

The economic impacts of aquaculture farming activity on the respective regions were as follows:

	North Coast	Mid North Coast	South Coast	All Regions	NSW
Initial Expenditure (\$m)	7.82	14.15	9.08	31.06	31.06
Output (\$m)	21.54	40.25	25.38	87.17	113.48
Value Added (\$m)	10.60	25.36	15.66	51.62	64.89
Household income (\$m)	4.37	11.63	6.88	22.88	30.00
Employment (no.)	143.6	361.2	182.1	686.9	748.1

Note: The totals for NSW include expenditure made between the coastal regions and other regions within NSW and interstate. Therefore, the totals (initial plus flow-ons) for All Regions will not sum to the total for NSW.

METHODOLOGY

WRI undertook economic modelling to understand the economic impact of aquaculture in NSW. Modelling was undertaken through input-output analysis, which 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 or an individual organisation including flow-on or multiplier effects.

Geographic scope

The regions for which the economic impacts were assessed were defined in consultation with the project coordinator at UTS and ANCORS. In order to account for the varying size of regions, possible overlap between them, expenditure patterns of aquaculture activity and difficulties in collecting the data, the regions have been defined at various levels of Australian Bureau of Statistics (ABS) statistical geography as in the table below. The respective study areas were delineated based on a recreational fishing economic impact study that WRI undertook in 2013.

Figure 1. Broader Study regions

Broader Region	Region	Statistical Area Level
1. North Coast	Clarence Valley	SA3
	Tweed Valley	SA3
	Richmond Valley Coastal and Hinterland	SA3
2. Mid North Coast	Mid North Coast	SA4
	Port Stephens	SA3
3. South Coast	Shoalhaven	SA3
	South Coast	SA3
4. NSW		State

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Data collection

In order to estimate the economic contribution of the aquaculture industry in NSW coastal regions, WRI used financial data provided by UTS and ANCORS. Fifty aquaculture businesses were approached by a courtesy phone call in November 2015 inviting them to participate in the survey. Twenty seven aquaculture businesses participated and their financial data was collected via a paper based survey. Surveys collected data on aquaculture costs and income.

Impact analysis

To estimate the economic contribution of the Aquaculture Industry in NSW, the relevant expenditure items were allocated to industries in the input-output tables, based on the sectoral allocation table used in the 2013 study (see appendix 2).

Reporting

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

- Initial impacts: defined as the value of the immediate changes in the respective region as a result of the aquaculture farming activities; 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 impact occurred.

The impact of aquaculture activity was estimated in terms of:

- Output, the value of goods and services that are produced within an establishment that become available for use outside that establishment, plus any goods and services produced for the organisation's own final use. Output is equal to total revenue plus any internal consumption.
- Value added, the amount by which the value of an article is increased at each step of its production, exclusive of its initial cost. Value added is equal to gross output minus intermediate inputs and 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. Value added sums the value added components of production through the supply chain, while initial expenditure includes multiple counting of expenditure through the supply chain. Value added is the most reliable measure of the actual value of production.
- Income, measuring 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, 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).

Assumptions

In the case of economic impacts by aquaculture activity, the expenditure modelled includes the following assumptions:

- Fixed and variable costs by aquaculture activity (profits and depreciation payments by operators are not considered).
- In consultation with Professor Alistair McIlgorm, revenues generated within each regional economy were apportioned over the sectors in which the income was received:
 - North Coast assumed that revenues were received as follows: 40% are exports from a combination of within NSW and QLD, 10% to local households, 20% Hospitality sector, 10% Retail Trade, 10% Wholesale Trade, 5% Food & Beverage Manufacture and 5% Agriculture Sector.
 - Mid North Coast assumed that revenues were received as follows: 58% are exports from a combination of within NSW and interstate, 15% to local households, 10% Hospitality sector, 5% Retail Trade, 2% Wholesale Trade, 8% Food & Beverage Manufacture and 2% from the Agriculture sector.
 - South Coast assumed that revenues were received as follows: 53% are exports from within the state, 7% Households, 10% Hospitality sector, 10% Retail Trade, 10% Food & Beverage Manufacture, 10% from the Agriculture sector.
- Full-Time Equivalent (FTE) Employment was estimated in consultation with Professor Alistair McIlgorm. As the aquaculture industry is largely seasonal, with employment consisting mainly of casual and permanent part-time staff, it is estimated that there are approximately 550 full-time equivalent jobs within the aquaculture industry across the three regions of interest.

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RESULTS

The results of the Industry Significance impact analysis are presented in the tables below.

North Coast

Initial expenditure in the North Coast region by aquaculture activity was \$7.8 million. Total impacts, including initial and flow-on impacts, were as follows:

- Total output for the region was \$21.54 million.
- Value added initial impact was \$5.14 million, with a total impact of \$10.60.
- Household income initial impact was \$2.41 million, with total impact of \$4.37 million.
- Initial Full Time Equivalent (FTE) is 110, generating 143 FTE for the regional economy.

Table 1. North Coast

Expenditure by region (\$m)	7.82			
	Output (\$m)	Value added (\$m)	Household income (\$m)	Employment (no.)
Initial	10.40	5.14	2.41	110.0
Flow-on	11.14	5.45	1.97	33.6
Total Impact	21.54	10.60	4.37	143.6

Note: Totals may not sum due to rounding.

ECONOMIC IMPACT OF COASTAL AQUACULTURE

Mid North Coast

Initial expenditure in the Mid North Coast region by aquaculture activity was \$14.15 million. Total impacts, including initial and flow-on impacts, were as follow:

- Total output for the region was \$40.25 million.
- Value added initial impact was \$15.67 million, with a total impact of \$25.36 million.
- Household income initial impact was \$7.18 million, with total impact of \$11.63 million.
- Across the regions, Mid North Coast generated the greatest level of initial Full Time Equivalent (FTE) of 297, contributing 361.2 FTE to the regional economy.

Table 2. Mid North Coast

Expenditure by region (\$m)	14.15			
	Output (\$m)	Value added (\$m)	Household income (\$m)	Employment (no.)
Initial	22.28	15.67	7.18	297.0
Flow-on	17.98	9.69	4.45	64.2
Total Impact	40.25	25.36	11.63	361.2

Note: Totals may not sum due to rounding.

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South Coast

Initial expenditure in the South Coast region by aquaculture activity was \$9.08 million. Total impacts, including initial and flow-on impacts, were as follows:

- Total output for the region was \$25.38 million.
- Value added initial impact was \$9.84 million, with a total impact of \$15.66 million.
- Household income initial impact was \$4.24 million, with total impact of \$6.88 million.
- Initial Full Time Equivalent (FTE) is 143, generating 182 FTE for the regional economy.

Table 3. South Coast

Expenditure by region (\$m)	9.08			
	Output (\$m)	Value added (\$m)	Household income (\$m)	Employment (no.)
Initial	14.48	9.84	4.24	143.0
Flow-on	10.89	5.82	2.64	39.1
Total Impact	25.38	15.66	6.88	182.1

Note: Totals may not sum due to rounding.

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All Regions

Initial total combined expenditure by the regions was \$31.06 million. Total impacts, including initial and flow-on by aquaculture activity, is estimated to have generated the following across the regional economy:

- A total of \$87.17 million in output for the regional economy.
- Value added initial impact was \$30.66 million, with a total impact of \$51.62 million.
- Household income initial impact was \$13.83 million, with total impact of \$22.88 million.
- Initial Full Time Equivalent (FTE) is 550, generating approximately 687 FTE for the regional economy.

Table 4. Total for all regions

Expenditure by region (\$m)	31.06			
	Output (\$m)	Value added (\$m)	Household income (\$m)	Employment (no.)
Initial	47.16	30.66	13.83	550
Flow-on	40.02	20.97	9.06	136.9
Total Impact	87.17	51.62	22.88	686.9

Note. Totals for NSW include expenditure made interstate and inland. Therefore, the expenditure for all regions will not sum to the total expenditure for NSW.

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NSW

At the NSW state level, total impacts, including initial and flow-on by aquaculture activity is estimated to have generated the following:

- The total impact for the state due to the Aquaculture Industry was approximately \$113.5 million in output.
- \$64.9 million in value added.
- \$30 million in household income.
- Approximately 748 (FTE) jobs in NSW.

Table 5. NSW

Expenditure by region (\$m)	31.06			
	Output (\$m)	Value added (\$m)	Household income (\$m)	Employment (no.)
Initial	47.44	30.66	13.83	550
Flow-on	66.04	34.23	16.18	198.1
Total Impact	113.48	64.89	30.00	748.1

Note. Totals for NSW include expenditure made interstate and inland. Therefore, the expenditure for all regions will not sum to the total expenditure for NSW.

CONCLUSION

At the NSW State level, Aquaculture farming generated approximately \$64.89 million in Value added (GRP), \$30 million in additional household income and total full-time equivalent employment of 748.

At the regional level, results from the economic modelling showed the greatest increase in GRP in the Mid North Coast region (\$25.36m), followed by the South Coast (\$15.66m) and North Coast (\$10.6m), with a total increase in GRP for all regions of \$51.62 million.

Household income had the highest impacts in the Mid North Coast (\$11.63m) followed by the South Coast (\$6.88m). The largest employment impacts were seen in the Mid North Coast (361), South Coast (182) and the North Coast (143) regions, with a total of approximately 686 FTE achieved across all regions.

Table 6. Impacts	North Coast	Mid North Coast	South Coast	All Regions	NSW
Initial Expenditure (\$m)	7.82	14.15	9.08	31.06	31.06
Output (\$m)	21.54	40.25	25.38	87.17	113.48
Value Added (\$m)	10.60	25.36	15.66	51.62	64.89
Household income (\$m)	4.37	11.63	6.88	22.88	30.00
Employment (no.)	143.6	361.2	182.1	686.9	748.1

Note: The totals for NSW include expenditure made between the coastal regions and other regions within NSW and interstate. Therefore, the totals (initial plus flow-on) for All Regions will not sum to the total for NSW.

APPENDIX 1: INPUT-OUTPUT ANALYSIS

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. Input-output modelling is one method of inter-industry modelling.

Constructing the Tables

The input-output tables for this project were extracted from the Australian Bureau of Statistics (ABS) 2009/10 national input-output table using the Generation of Regional Input-Output Tables (GRIT) technique. The national table was adjusted to represent New South Wales and the subsequent study regions using detailed data from:

- 2011 Census;
- 2012/13 National State Accounts for New South Wales (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 tables created were for financial year 2013/14.

The tables for this project have 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 elsewhere in 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 holistic 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.

Marginal Coefficients Model

One of the main limitations of input-output tables is the assumption of linear coefficients. To address this problem and the associated problem of overestimation, the input-output analysis undertaken for the Aquaculture Industry incorporates the marginal coefficients model which attempts to overcome the limitations of traditional input-output analysis by removing the assumption of linear coefficients for the household sector. As is well documented in literature, the household sector is the dominant component of multiplier effects in an input-output table so using marginal income coefficients for the household sector only provides a more accurate estimate of the multiplier effects and provides results closer to those of a computable general equilibrium (CGE) model. This provides more accurate estimates of the significance of impacts associated with Aquaculture Activity, than would be possible with traditional input-output analysis.

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.

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 the aquaculture industry. The Industry Significance approach was used to model the operations of aquaculture activity.

Operational data was used to construct a new sector in the input-output table representing the aquaculture operations in the respective coastal economies. Adjustments were made to the original Agriculture, Forestry & Fishing sector to reflect this division.

Location quotients

Since expenditure items may not be produced locally, a location quotients matrix was applied in the model. This process effectively removes a proportion of total expenditure that represents expenditure made on imports into the relevant region.

Note: In calculating the economic impact of Aquaculture production 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 data¹.

¹ 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>

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APPENDIX 2: ALLOCATION OF EXPENDITURE ITEMS

Expenditure Item	Proportion allocated	Allocation to Industry
Fuel/oil	75%	Chemical Manufacture
	25%	Transport, Postal and Warehousing
Repairs and Maintenance	50%	Textile, Clothing, Footwear & Leather
	50%	Manufacturing Other Manufacturing
Clothing	100%	Textile, Clothing, Footwear & Leather Manufacturing
Hire cost	100%	Rental, Hiring, and Real Estate Services
Freight/packaging	100%	Transport, Postal and Warehousing
On-grower purchases	100%	Agriculture, Forestry & Fishing
Fish food	100%	Agriculture, Forestry & Fishing
EPA/lab testing/Field consumables	100%	Professional, Scientific and Technical Services
Business Licence/permits	100%	Public Administration & Safety
Vehicle registration and insurances	100%	Public Administration & Safety
Mooring/slippage fee	100%	Public Administration & Safety
Accounting fee	75%	Professional, Scientific and Technical Services
	25%	Finance & Insurance
Legal cost	100%	Professional, Scientific and Technical Services
Phone	100%	Information, Media and Communications
Stationery	100%	Printing, Publishing & Recorded Media
Electricity/gas	100%	Electricity, Gas and Water Supply
Bank charges	100%	Finance & Insurance
Interest	100%	Finance & Insurance
Travel cost	25%	Chemical Manufacture
	25%	Transport, Postal and Warehousing
	50%	Accommodation, Café & Restaurants
Membership levies	75%	Professional, Scientific and Technical Services
	25%	Finance & Insurance
Marketing and promotions	75%	Professional, Scientific and Technical Services
	25%	Finance & Insurance
Leasing fee	50%	Rental, Hiring, and Real Estate Services
	50%	Public Administration & Safety
Other	4%	Apportioned across 26 sectors

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.

Ms Wendy Mason – General Manager

Wendy joins the WRI team as General Manager from her former position as Head of the Commonwealth Bank Foundation. Wendy comes to the Western Research Institute Limited with extensive management and business development experience, excellent networks, and a substantial track record in stakeholder relations across the government, financial and not-for-profit sectors; and experience as a major end-user of research to support best practice outcomes.

Bringing with her formal qualifications in education and psychology from the University of Sydney, a Graduate Certificate in Human Resource Management and Graduate Certificate in Business (Marketing), Wendy also holds an Australian Institute of Company Director's Diploma of Business (Governance).

Mr Alistair MacLennan – Senior Research Consultant

BA Political Economy, First Class Honours (UNE)

Having served in a variety of parliamentary, public service and private sector roles, Alistair brings a wealth of research experience to WRI. Alistair has well developed skills in data analysis, economics and business, and has a wide understanding of government. In addition, Alistair also has experience in policy development in the energy sector, where he engaged with industry, government agencies and NGOs to inform policy. Alistair's experience in engaging with clients, stakeholders and the public assists WRI to fully understand its client's needs and provide tailored research.

Ms Danielle Ranshaw – Senior Research Consultant

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.

Ms Wai Matthews – Research Officer

BBus (Finance/Economics) CSU

With a background in Business Administration and Bookkeeping, Wai brings to WRI strong experience and knowledge in local business operations, management and finance. Wai has great interest in economic issues affecting regional areas which led to her attaining an internship with the NSW Department of Industry as an Economic Analyst. As an intern, Wai has gained a wealth of knowledge and experience in data analytics and reporting as well as a good understanding of government. Wai is currently undertaking Post Graduate study in Applied Statistics to further her skills.

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. Dale brings a high level of organisational skill to her role as Executive Officer.

