The Northland Regional Economic Impacts of Aquaculture

Final Report

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Executive Summary

Aquaculture is one of the fastest-growing food production sectors In New Zealand. In 2008, industry exports equated to $265 million (Aquaculture New Zealand 2009). Sales (output) currently average around $370 million annually (Ernst & Young 2009). The goal for the New Zealand aquaculture sector is to achieve $1 billion in sales by 2025[1].

The Northland Regional Council (NRC) has identified marine farming as an important industry to its region. There are currently 700 hectares (ha) consented for inter-tidal oyster farms in Northland and 43 ha for mussel farming. No commercial finfish farming is operative at present.

Northland's aquaculture potential, assuming all the existing productive and hypothetical space is developed, is significant. The regional income is estimated at $216 million per year and 2,821 FTEs (including multiplier effects). It also has the potential to contribute an estimated $407 million to the national goal of $1 billion in sales (output) by 2025.

Of Northlands 700 ha of consented oyster farming area, only around 313 ha is productive. A total of approximately 150 ha of the remaining consented area have the potential to be developed, while the remainder is unsuitable for farm use.

Economic impact assessment (EIA) was used to evaluate the economic activities of off-shore aquaculture (i.e. not land-based) on the Northland economy. The assessment included farming and processing activities. The assessment was broken into two parts; the first looking at the existing productive and potential industry, and the second a hypothetical situation of 765 ha of additional oyster farms and 190 ha of finfish space[2].

Combined oyster farming and processing from the existing productive 313 ha is estimated to directly contribute $19 million to regional income[3] and create 336 FTE jobs[4]. Multiplier effects increase total economic impacts to $30 million of regional income and 465 FTE jobs (Table 1).

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[1] The New Zealand Aquaculture Strategy was commissioned by the New Zealand Aquaculture Council with the assistance of the New Zealand Seafood Industry Council and the Ministry of Economic Development. The strategy was written by Mike Burrell and Lisa Meehan of LECG Ltd, with the assistance of Sally Munro of Munro Duignan Ltd, and input from industry, government, iwi, and other stakeholders.

[2] The 190 ha are made up of ten farm units. A farm unit represents 10 - 20 ha of seafloor area including 2 ha of cages and producing 2,500 tonnes per cycle (equivalent to 1,250 tonnes per year).

[3] Regional income is the same things as regional GDP. It is the returns to labour and capital, and is the equivalent of EBITDA (Earnings before Interest, Taxes, Depreciation, and Amortization) + wages and salaries.

[4] Full Time Equivalent = 1 Full time permanent job or 2 part time permanent jobs or 2 Full Time seasonal jobs *or* 4 part time seasonal jobs.

Table 1 Aquaculture's contribution to Northland's economy (regional income)

Note: Figures quoted include multipliers

	Existing		Future*	
Oysters[#]	$30 m/ yr	465 FTEs	$116 m / yr	1821 FTEs
Kingfish	0	0	$100 m / yr	1000 FTEs
Total	**$30 m/ yr**	**465 FTEs**	**$216 m / yr**	**2821 FTEs**

[#]Assumes 50% of the processing of Northland's farmed oysters occurs in Northland.
*Includes the existing oyster farming area (313 ha), the currently undeveloped but productive oyster area (150ha) and hypothetical areas (765ha – oysters, 190ha – kingfish).

Combined oyster farming and processing from the 150 ha of consented area, which has the potential to be still developed, could potentially directly contribute an additional $9 million to regional income and create 201 FTE jobs. Multiplier effects increase these total economic impacts to $14 million of regional income and 223 FTE jobs.

Combined oyster farming and processing from the hypothetical additional oyster farm area of 765 ha could potentially directly contribute $46 million to regional income and create 819 FTE jobs. Multiplier effects increase total economic impacts to $72 million of regional income and 1,133 FTE jobs.

The potential for the hypothetical 190 ha farmed finfish area, with a vertically integrated processing and marketing operation[5], would be to generate $100 million of regional income and 1,000 FTE jobs (including multiplier effects) (Table 1).

The total consented area for mussel farming is 43 ha, but only 24 ha have been developed. Given the small area of mussel farming active, the value of mussel farming to the Northland economy is estimated to be minor.

Northland's aquaculture potential, assuming all the existing productive and hypothetical space is developed, is significant. The regional income is estimated at $216 million per year and 2,821 FTEs (including multiplier effects). It also has the potential to contribute an estimated $407 million to the national goal of $1 billion in sales (output) by 2025.

All of the figures quoted should be used with caution. They are based on a range of assumptions and a limited amount of 'real' data.

[5] Vertical integration describes a style of management control. Vertically integrated companies are united through a hierarchy with a common owner. All stages of production, from farming to processing the final product, are controlled by one company.

Definitions

Direct Economic Impacts - The direct impact arises from the production by marine farmers of goods and services. The direct employment is of people who work on the marine farms. The direct output is the value of sales made by marine farmers at their usual point of sale. The direct value-added is the value-added in those marine farming businesses. It is the returns to land labour and capital and is equivalent to EBITDA (Earnings before Interest, Taxes, Depreciation, and Amortization) plus wages.

Downstream Impacts - Impacts which are not driven by an activity's demand for extra inputs, but which might arise as a result of a particular activity, are sometimes called the "downstream impacts". An example in marine farming is fish processing, because the increase in farm output leads to increased activity in the processing works. The processing industries do not provide an input into marine farming, and hence are not an indirect or induced effect of marine farming. They are a downstream effect and have been estimated separately in this study.

EBITDA is the acronym for earnings before interest, taxes, depreciation, and amortisation. EBITDA can be used to analyse and compare profitability between companies and industries, because it eliminates financing and accounting effects.

Employment is work done by employees and self-employed persons, and is measured in Full-Time-Equivalent jobs (FTEs). The respondents were asked to estimate FTEs of a part time job on the basis of a 40 hr week for a full year per FTE. Hence 20 hours per week is 0.5 FTEs.

Where work is seasonal, the conversion to FTEs is based on 12 months' work per year. So a seasonal worker working full time for six months per year is 0.5 FTEs, and a part time seasonal worker working ten hours per week for six months is 0.125 FTEs.

Household Income is the gross income of households. It includes the income of self-employed persons. There is sometimes considerable uncertainty as to the proportion of business income which goes to households and this is particularly the case for small businesses, where tax accounts are more likely to show various forms of income and drawings which are tax effective as opposed to a realistic assessment of the actual flows of funds during the year. When estimating indirect economic impacts, one needs to know the increase in household income which occurs in the District and how it will be spent.

Indirect Economic Impacts - The indirect impact arises from increased spending by businesses as they buy additional inputs so that they can increase production. This indirect effect can be envisaged as an expanding ripple effect. A marine farmer sells fish, but has to buy fishfeed and hire a contractor to maintain nets. The contractor has to buy fuel and get his boat serviced. The mechanic has to purchase electricity and waste disposal services to operate his business. All of these businesses have to employ more staff to cope with the increase in work. All the increased employment, output and value-added (apart from that on the marine farm) is the indirect effect. Note that indirect effects only include "upstream" effects (via buying more inputs), but do not include any stimulated development downstream which is addressed separately.

Induced Economic Impact - The induced impact is the result of increased household income being earned and spent, and leading to a further ripple effect of increased employment, output and income.

Multiplier - The Type II multiplier is the ratio of the total effects: direct effects. So an employment multiplier of 2.7 indicates that for every 1 job on marine farms, there are a further 1.7 jobs (total of 2.7) created elsewhere in the region. A multiplier may also be expressed as the ratio of total jobs per $1 million direct output of marine farms, and would be expressed as FTE jobs / $million direct output.

Output is the value of sales by a business. In the case of wholesale and retail trade, it is the total value of turnover (and not simply gross margins).

Regional Income is the same concept as regional value added and regional GDP. They are all equivalent to the returns to labour and capital. In accounting terms they are all equivalent to EBITDA + wages and salaries.

Total Economic Impacts - The total impact is the sum of the direct, indirect and induced impacts.

Value-Added includes returns to labour (wages and salaries and self-employed income), and returns to capital (including interest, depreciation and profits). It also includes all direct and indirect taxes. Value added is analogous to regional GDP (Gross Domestic Product).

1 Introduction

1.1 Background

Aquaculture is one of the fastest-growing food production sectors in New Zealand. In 2008, industry exports equated to $265 million (Aquaculture New Zealand 2009). Sales currently average around $370 million annually (Ernst & Young 2009). The goal of the New Zealand Aquaculture Council is for the aquaculture sector to meet the $1 billion product target set in the Aquaculture Strategy for 2025[6].

Aquaculture shares 20 percent of the total fisheries production in value and 15 percent of New Zealand's seafood exports by revenue[7]. Future growth of this sector is expected largely to come from exports. Key exports products are Pacific Oysters, Greenshell™ Mussel and King Salmon.

New Zealand has traditionally farmed shellfish; however the future for aquaculture may hold a different outlook and focus increasingly on higher value added products. New finfish species such as hapuku and kingfish are on the verge of becoming commercially viable and many experimental species such as sponges, seahorses, eels and seaweeds are being extensively researched. In addition existing shellfish activities are expected to expand considerably. New trials on conditioning mussels and oysters to achieve productivity gains and better taste are some of the advances the industry is pursuing. These innovative products with an often higher value will bring a new dimension to the current industry and regulatory environment.

There is also potential, particularly for Northland, for the development of special purpose farms, e.g. for tourism, education or pharmaceutical purposes. Seafood harvested from aquaculture and combined with tourism activities can play an important role in promoting more sustainable forms of seafood tourism associated with marine resources, heritage, and culture. A prime example is the Wairakei Prawn Farm, which has successfully researched and developed the ability to breed and grow tropical prawns in captivity using geothermal

[6] The New Zealand Aquaculture Strategy was commissioned by the New Zealand Aquaculture Council with the assistance of the New Zealand Seafood Industry Council and the Ministry of Economic Development. The strategy was written by Mike Burrell and Lisa Meehan of LECG Ltd, with the assistance of Sally Munro of Munro Duignan Ltd, and input from industry, government, iwi, and other stakeholders.

[7] http://www.aquaculture.org.nz/aquaculture-in-nz/industry-overview/key-facts/ downloaded 16th October

heat and to function as a tourism operation[8]. There are wider socio-economic benefits associated with such developments, but these are still in the early stages in New Zealand.

Against this background, the Northland Regional Council (NRC) has identified aquaculture as an important industry to its region. Aquaculture activities provide for the social and economic wellbeing of people and communities by creating jobs and contributing directly and indirectly to the economy.

The turnover of aquaculture in 1993 was $10 million. This had doubled to $20 million by 2003 (Jeffs 2003). The existing aquaculture industry in Northland consists of 747 ha of consented space made up of 700 ha for inter tidal oyster farms, 43 ha for mussel farms, and the remainder a mix of oyster and mussel spat catching. There is no commercial finfish farming operative at present. An on-land kingfish farm was built and operated on the shores of the Parengarenga harbour for two years until it closed in 2006. The NIWA's Bream Bay Aquaculture Park hosts aquaculture research facilities and New Zealand's largest commercial paua farm.

The NRC has been actively planning for new aquaculture space for the last eight years. In order to effectively plan for new space, an increased understanding of the economic implications of aquaculture in the region is necessary. Economic information on how aquaculture contributes towards employment, GDP and other sectors will enhance future decision-making of the NRC.

1.2 Project requirements

NRC has commissioned Enveco to assess the economic impacts of aquaculture at a regional scale. The knowledge of the effects of this industry on the economy is essential to inform politicians, planners and the community as it brings insights into where the distributive benefits and costs of farming activities arise.

The objectives as outlined in the Request for Proposal (RFP) were:

1. To assess the regional economic impacts of the existing aquaculture industry (marine farming and processing) in the Northland Region. This includes 700 ha of oyster and 43 ha of mussel farms.

[8] The farm produces up to 32 tonnes of prawns per annum, with 24 tonnes being sold through the farm restaurant as a value-added product, attracting 200,000 visitors per year (http://www.nzaquaculture.co.nz/AQUACULTURE%2005.pdf downloaded 27th October).

2. To assess the potential regional economic impacts of the development of a suite of new (hypothetical) marine farming areas throughout Northland and the processing of product from those farms. This includes 765 ha of oyster and 190 ha of finfish space. A list and map of the hypothetical sites can be found in Appendix One.

The hypothetical marine farming areas are a 'best guess' of the type and location of new aquaculture development over the next 10 - 20 years. They are primarily based on a suite of areas identified by the Ministry for the Environment, as part of a proposed project to confirm the feasibility of aquaculture at the identified sites[9]. It should be noted that though these areas broadly have some attributes desirable for aquaculture, their inclusion cannot be taken to infer that aquaculture is viable in these areas – in either a physical sense or environmentally.

The economic analysis focuses on off-shore aquaculture (i.e. does not include land based aquaculture) including farming and processing activities in the Region. An estimation of the positive effects of aquaculture on other economic activities such as support industries, tourism and fishing has been built-in to the methodology. As an output of this process, a robust and defensible assessment of the regional economic impacts of present and future aquaculture activities has been provided.

As related to the objectives, the following impacts were assessed:

1. The economic impacts of existing oyster farms and related processing.

2. The economic impacts of new (hypothetical) oyster farms and related processing to be developed.

3. The economic impact of new (hypothetical) finfish farms and related processing.

The economic impacts of mussels have not been estimated as the farmed area is very small and no data was obtained from any of the mussel farmers in Northland.

[9] Ministry for the Environment, Draft Northland AMA Project Plan, April 2009,

2 Regional Industry

2.1 Introduction

Commercial aquaculture has been active in Northland for over 40 years. The first farming activity involved native rock oysters in the Bay of Islands (Jeffs 2003). Subsequently the Pacific Oyster was introduced to Northland – a more viable alternative to the native rock oyster due to the speed of the growth cycle and the ease of spat catching. Since the 1970s, aquaculture has continued to grow in Northland. By 1993, it was estimated that aquaculture, mainly oyster farming, generated $9 million in revenue and provided $3.4 million directly to the Northland economy; and employed 272 people (Jeffs 2003).

By the end of the 1990s, Northland aquaculture turnover had doubled (Jeffs 2003). This represents a slower growth rate than New Zealand as a whole, and Australia, but is typical for the rest of the world averaging 11% growth per annum (Jeffs 2003).

The current consented aquaculture in Northland is as follows[10]:

- Total area: 747 ha
- Oyster farming: 700 ha
- Mussel farming: 43 ha
- Mussel spat catching: 2.4 ha
- Oyster spat catching: 1 ha
- Other (aquarium): 0.1 ha

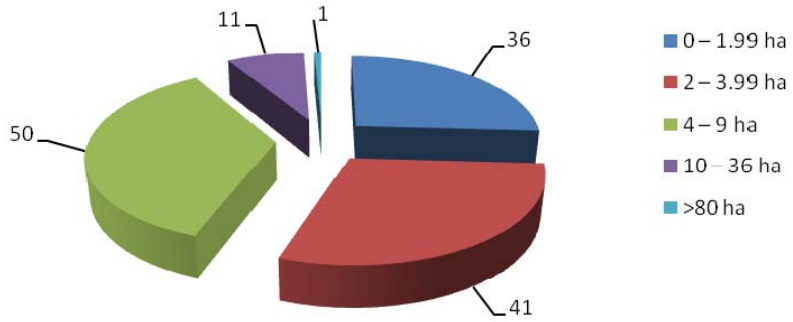
2.2 Pacific oyster farming

Pacific oyster farming is an important traditional crop for New Zealand aquaculture farmers. In 2008, New Zealand exported NZ$16.9 million worth of Pacific Oysters (Aquaculture NZ 2009). The majority of Pacific Oysters are exported in frozen half shell format (75.72%) to Australia (Aquaculture NZ 2009).

[10] This does not represent the total productive area.

The region currently produces 47% of total national oyster production (Aquaculture New Zealand 2009). The majority of oyster farms are located in Whangaroa, Bay of islands, Houhora, Kaipara (spat catching) and Parengarenga Harbour (Jeffs 2003). Smaller groups of farms are located in Rangaunu Harbour, Te Puna Inlet, Whangarei Harbour and the Kerikeri Inlet[11]. The distribution of the number of oyster farms across different farm sizes can be seen in the graph below. There are 132 individual oyster farming and 1 oyster spat catching farm resource consents.

Graph 1 Number and size of farms according to size



Approximately 91% of oyster farms are less than 10 ha in size (127 farms), and 26% are less than two ha (36 ha)[12]. The largest consented oyster farm area is 81 ha.

There are 67 registered individual operators in Northland. However, in reality this number is likely to be less given that some operators put their farms into different names. The industry is dominated by two operators; Sanford Ltd and Aotearoa Fisheries Ltd, with 128 ha and 190 ha[13] respectively of consented area – 45% of the total consented area. The next five largest operators own 38 ha, 23 ha, 22 ha, 17 ha and 12 ha respectively. Ignoring the two largest operators, the average consented area owned by an operator is 6 ha.

Total area of Oyster Farming in Northland

Northland has 700 ha of consented oyster farm areas. Not all areas consented are productive. It has been estimated that in 2007, only 51.9% of the consented area was

[11] Northland Regional Council consent data, October 2009.
[12] Note that some oyster farms are made up of two or more resource consents.
[13] Note, Aotearoa Fisheries Ltd owns the single largest consented oyster farming area of 81 ha in the Kaipara Harbour, which is understood to only be used for spat catching (approximately 4 ha in 2007).

developed, i.e. 363 ha[14]. It was estimated that around 50 ha of the developed area is 'damaged' and not productive[15]. Therefore the actual productive area remaining is estimated to be 313 ha. A total of 150 ha of the remaining consented area have the potential to be still developed[16]. An additional hypothetical area of 765 ha has been suggested. Economic impacts have been calculated based on the currently productive space (313 ha), the potential area (150 ha) and the hypothetical area (765 ha).

2.3 Mussel

The aquaculture crop, Greenshell™ Mussels is relatively easy to produce in particular parts of New Zealand, but it also achieves relatively low economic gains. Despite this, it remains an important aquaculture crop for New Zealand. Nationally, the New Zealand Greenshell™ Mussels are the single most important export seafood commodity valued at NZ$204.3 million (Aquaculture NZ 2009). The largest market for the Mussel is the United States and, like oysters, export products typically take the form of frozen half shells (84.05%) (Aquaculture New Zealand 2009).

There is currently very little mussel farming in Northland. Out of the 43 ha of consented mussel farming area, only 24 ha have been developed. Given the small area of mussel farming active in Northland, the value of mussel farming to the Northland economy is estimated to be minor.

The more important economic activity for mussel farming is the collection of mussel spat from Ninety Mile Beach. In the early 2000s, the spat gathering industry employed 25 people and generated $1.5m in sales per annum (Jeffs 2003). Spat gathering is not included in this analysis, as it is not by definition aquaculture, but considered fishing.

2.4 Finfish

The only commercial finfish aquaculture active in New Zealand is the production of King Salmon, also called Chinook (Aquaculture New Zealand 2009). In 2008 exports were valued at NZ$43.9 million. The largest export market is the United States, followed closely by Japan and Australia. Products are typically exported in the chilled whole format (57%) (Aquaculture New Zealand 2009). King Salmon is not feasible for aquaculture production in

[14] In 2007, 700 Ha of oyster farms were consented.

[15] The estimates were made by Northland Regional Council staff. Some of the 'damaged' area was assumed not to be in production given the bad state of repair of the structures.

[16] The estimates were made by Northland Regional Council staff.

Northland, principally because the water temperature is too high. Species such as hapuku (i.e. groper) and kingfish represent possibilities for the future.

Currently no finfish farms are commercially active in Northland. Extensive research capital has been established at Bream Bay Aquaculture Park by NIWA, which has invested more than $2.5 million in aquaculture production and research facilities to help New Zealand meet the growing demand for seafood[17]. Over recent years, trials on snapper, kingfish, hapuku and other species have been undertaken at the research facility. The fundamental issues of broodstock collection and development of commercial systems for spawning, egg incubation, larval and juvenile rearing have been resolved. However, large scale production of fingerlings (i.e. over 0.5 million) is not yet feasible.

Due to the warm water conditions in Northland, the prospects for developing snapper, hapuku and kingfish marine farms have considerable potential. The warmer sea temperatures (14-21^{o}C) promote faster growth and hence greater economic return (Poortenaar et al. 2003). Some fingerlings could initially be sourced from Bream Bay, but several independent hatcheries would need to be commissioned to minimise biosecurity risk for sale to marine farms located out at sea. The potential for finfish farm development in Northland remains substantial, but is subject to overcoming a number of technical barriers.

[17] http://www.niwa.co.nz/our-science/fisheries/publications/all/fau/2002-02/bream downloaded 16th October 2009.

3 Methodology

3.1 Introduction

In 2006 a methodology was developed for assessing the economic effects of aquaculture at a regional and local scale (PwC 2006). The methodology involved an Economic Analysis Framework (EAF) consisting of a combination of several methodologies including economic impact assessment (EIA), cost-benefit analysis and multi-criteria analysis. The objective of the EAF was to provide guidance to regional councils on how to assess the impacts of existing and future aquaculture development.

The NRC has commissioned this study using the EAF, to estimate the economic impacts of aquaculture to the Northland Region. Based on the EAF, the EIA is considered to be the most appropriate methodology to use to estimate the economic effects of aquaculture on the local economy.

3.2 Applied methodology

Economic impact assessment (EIA) is a methodology designed to evaluate the importance and intensity of economic activities of a particular sector such as aquaculture. The EIA assesses how aquaculture as an industry 'adds value' to the Northland economy – the extent to which it contributes to regional employment, regional income (GDP) and other industries such as tourism and fisheries. The goal of the EIA is to identify, and where possible measure in monetary terms as many of the impacts of aquaculture activities on the economy of the region.

The EIA in this report analysed the following layers of economic impacts:

- direct impacts relating to the injection of capital specifically linked to the aquaculture industry;
- indirect impacts arising as a consequence of changes in the level and value of sales for suppliers of goods and services to the aquaculture industry; and
- induced impacts originating from increased household incomes earned from aquaculture activities and supporting industries, and their consequential expenditure on goods and services in the region.

Direct economic impacts occur when the aquaculture industry purchases goods and services from other suppliers in the course of delivering aquaculture services and products. These economic impacts take place all along the value chain of aquaculture, and include capital expenditure to start the business, on-going operational expenditure and processing activities. Capital expenditure for aquaculture activities can be significant, in the tens of millions of dollars, particularly for more extensive and complex aquaculture farming such as finfish.

However, capital costs remain 'one-off' costs and over time do not contribute significantly to the local economy. Operating expenses are more significant, such as feed and electricity use for finfish farming, or longlines and processing equipment for shell fish. Often it is the processing costs, which have the largest impact on employment, as more people are required in this than for farming. Expenditure of this kind has positive repercussions across the region.

The indirect and induced effects on the economy are a consequence of direct expenditure on aquaculture business activities and enhance the effects of the original spending. They have the tendency to magnify direct impacts. As a result of aquaculture, households have gained income which they then spend on other goods and services.

The following steps for the EIA were followed:

1. Data collection process - design of an industry questionnaire and analysis.
2. Calculation of multipliers using the primary data collected.
3. Assessment of direct, indirect and induced economic impacts for existing and future aquaculture activities using the multipliers.

3.3 Data collection process

The data collection was based on a questionnaire sent to all existing marine farm operators and processors in Northland, and included the following steps:

- A questionnaire was prepared based on recent relevant studies (PwC 2006; ARC n.d.). The questionnaire consisted of three differently structured farms – farmers only, processors only and combined farming and processors (Appendix Two).

- The NRC provided Enveco with a list of all the current marine farm consent holders in Northland Region. Prior to being sent the questionnaire, consent holders were sent an endorsement letter by the NRC asking marine farms for the cooperation in the EIA (see Appendix Three).

- The questionnaire asked specific information on the cost and benefit structures of marine farming and processing activities such as operational expenditures, revenue and output figures, employment details and future aspirations.

- Discussions with Mike Mandeno (Aquaculture New Zealand) and Tom Hollings (New Zealand Oyster Industry Association) led to the identification of four active processing firms within the Northland Region. Those businesses were sent a more detailed questionnaire on their processing activities.

- A hard copy of the questionnaire was sent to all marine farmers, who were asked to fill out the questionnaire on-line and return it. Enveco was responsible for the collection and holding of data. Where requested by respondents, confidentiality agreements were set in place with Enveco to ensure the non-disclosure of commercially sensitive data (see Appendix Two).

- Follow-up phone calls were made to those marine farmers that did not respond initially, to encourage further responses.

Despite the efforts undertaken during this study, the return rate to the surveys has been low. Of the 52 marine farmers contacted, 9 responded, although these accounted for about one third of the area farmed.[18] See section 4.1.1 for a discussion of the implications of the response rate on the findings of the EIA.

3.4 Input-output tables

Input-output tables analyse the individual components of the economy such as industries, goods, services and final users. The tables show the interactions and dependencies between industries (Statistics New Zealand 2003). Input-output tables rely on mathematical representations of economies that model the relationship between consumers and producers, and the interdependencies of industry. EIA typically uses input-

[18] Although the names of 67 resource consent holders were provided by NRC, they included some double-ups, e.g. same operator having several farms under different names, and some which have gone out of business.

output tables to calculate multipliers, which measure how the change in the activity level of one industry affects another (Covec 2006).

The results from the questionnaire were scaled to calculate sector impacts across the region. Multipliers were then assessed based on an input-output model, which uses a matrix representation of a national or regional economy to predict the effect of changes in one industry on others and by consumers, government, and foreign suppliers on the economy.[19] Appendix four contains details on the economic model used in this study.

3.5 Multipliers calculation

Multipliers summarise the economic interdependence between aquaculture and other sectors. Augmenting the final demand for any sector has repercussions throughout the whole economy, causing the output to rise beyond the initial change in demand. This is known as the multiplier effect. Based on the input-output model, output, value-added, household income and employment multipliers were developed.[20] The estimated revenues and expenditures were then translated into total economic impacts using these regional multipliers.

3.6 Assessment of regional economic impacts

Economic impacts (direct and total) were broken down into the contribution towards processing and farming respectively, and according to existing and hypothetical shellfish farming, and hypothetical finfish farming. Results were tabulated according to per hectare impact, total area consented, total area actually farmed, and hypothetical areas.

3.7 Future data collection

Every industry would benefit from understanding the economic implications of its operations. The aquaculture industry does not currently collect data (other than exports). Regional councils are not well placed to collect aquaculture data, because marine farmers have some scepticism of regional councils collecting data given their regulatory role in marine farming. Rather than regional councils collecting aquaculture data, leadership from Aquaculture New Zealand would prove more beneficial as the benefits of growth in the industry primarily exist with their constituents.

[19] Model from Geoff Butcher of Butcher Partners Ltd.

[20] A multiplier is the ratio of total impacts: direct impact. Multipliers may also be expressed as the ratio of total impacts: direct output.

4 Economic impact assessment

4.1 Current and proposed shellfish aquaculture production

4.1.1 Oyster Farming Survey

Response rate and variability

Of the 52 marine farmers contacted, only 9 responded, although these accounted for about one third of the area farmed.[21] Of those who responded, only 4 provided sufficiently detailed data to use in calculating economic multipliers, and one of those had considerable difficulty in splitting figures between farming and processing activities. Multipliers were calculated by both including and excluding this respondent. The multipliers excluding this respondent are more reliable, and those have been used in this report.

All of the aquaculture EIA studies undertaken to date in New Zealand have been hindered by a lack of accurate survey information. However that does not make the results of the EIA unreliable. Out of all the respondents, only a few farms were selected for use in the analysis, i.e. those with the most consistent and accurate data. Therefore overall estimates still provide a good indication of the economic impacts of aquaculture in Northland, although figures could be refined over time by the inclusion of further data.

There was a degree of variability in most of the parameters measured by all respondents:

Regional Output

Regional output of oysters per year ranged from 0.5 tonnes / ha to 25 tonnes / ha of developed farm, and from $5,000 to $83,000 / ha. The median figures were 11 tonnes and $37,000 per ha.[22] However, some farms were still in the development stage, and some respondents had combined farming and processing operations and had difficulty in splitting out their financial results into the two activities. Others were processing several different species and did not record costs separately between them. Therefore only those respondents who appeared to have the most complete and reliable figures for production from oyster farms were used in analysis. The average of these farms was 23 tonnes and $53,000 per ha per year at an average price of $2,400 per tonne (the range over all farms was $1,400 - $4,200 per tonne) - these are the figures that were used in the analysis.

[21] Although the names of 67 resource consent holders were provided by NRC, this included some double-ups and some which have gone out of business.

[22] Choosing the median figure (rather than average) eliminates the misleading extreme figures.

Given feedback from the New Zealand Oyster Industry Association[23], the average figures are higher than what is typically expected from industry. One explanation could be that most of the respondents have the benefit of large scale production, resulting in productivity gains when compared to smaller farms. Hence these figures may not represent average economic impacts, but rather the higher end of the industry.

Employment

The number of jobs varied from 6 to 14 FTEs[24] / $1 million of revenue[25], and from 0.15 to 1.1 FTEs / developed ha. For the respondents, who appeared to have the most complete and reliable figures for production from farms the average employment ratio was 12.6 FTEs / $1 million of revenue, and 0.67 FTEs / developed ha.

Household Income

For the respondents, who appeared to have the most complete and reliable figures for production from farms the average income was $28,000 / FTE and $19,000 / productive ha.

Direct and Total Economic Impacts of Oyster Farming in Northland

The expenditure patterns of the respondents with the most complete and reliable figures for productive farms were incorporated into a Northland regional input – output model developed for this project[26]. Multipliers have been calculated and applied to the direct economic impacts described above; to give total economic impacts per ha of productive oyster farm in Northland. The vast majority of the multiplier effects arose from household spending, because wages and salaries were 52% of respondent's total operating expenditure.

The results suggest that total regional output generated by 1 ha of productive oyster farm is $94,000. Included in this is $54,000 of regional business and household income[27], which includes $30,000 of household income, and 0.93 FTE jobs.

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[23] Correspondence with Tom Hollings, December 2009.

[24] Full Time Equivalent = 1 Full time permanent job *or* 2 part time permanent jobs *or* 2 Full Time seasonal jobs *or* 4 part time seasonal jobs.

[25] Revenue is defined as the total amount of money received by a business for goods sold or services provided during a certain time period.

[26] Based on a 2005-06 national model (*Stroombergen and Nana 2008)*, and modified to take account of regional self-sufficiency and purchasing patterns reported by respondents.

[27] Commonly called Value Added – analogous to regional GDP.

It is estimated that the productive oyster farms (313 ha) directly generate $10 million of regional income (including $6 million of wages and salaries), and 210 jobs. This is based on the assumption of uniform regional output and employment over all farms. Multiplier effects increase the total regional income to $17 million (including $9 million of household income) and 292 FTE jobs (Table 2). The potential for the consented but undeveloped oyster farm area of 150 ha is to generate directly $5 million of regional income (including $3 million of wages and salaries), and 100 FTE jobs. Multiplier effects increase the regional income to $8 million (including $5 million of household income) and 140 FTE jobs (Table 2).

Table 2 Direct Impacts, Multiplier and Total Impacts of Oyster Farming in Northland

	Per ha	All Northland Productive Area (313 ha)	All Northland Consented Area with Potential (150 ha)	Additional hypothetical Consented Area (765 ha)	Total
Direct Impacts					
Regional Output[28]	$53,000 / yr	$17 m / yr	$8 m / yr	$41 m / yr	$66 m / yr
Employment	0.67 FTEs	210 FTEs	100 FTEs	513 FTEs	823 FTEs
Household Income	$19,000 / yr	$6 m / yr	$3 m / yr	$15 m / yr	$24 m / yr
Regional Income (Value Added)[29]	$33,000 / yr	$10 m / yr	$5 m / yr	$25 m / yr	$40 m / yr
Multipliers					
Regional Output	1.76				
Employment	1.38				
Household Income	1.60				
Regional Income (Value Added)	1.62				
Total Impacts					
Regional Output	$94,000 / yr	$30 m / yr	$14 m / yr	$72 m / yr	$115 m / yr
Employment	0.93 FTEs	292 FTEs	140 FTEs	712 FTEs	1144 FTEs
Household Income	$30,000 / yr	$9 m / yr	$5 m / yr	$23 m / yr	$37 m / yr
Regional Income (Value Added)	$54,000 / yr	$17 m / yr	$8 m / yr	$41 m / yr	$66 m / yr

[28] Output is the value of sales by a business. In the case of wholesale and retail trade, it is the total value of turnover (and not simply gross margins).

[29] Value-Added includes returns to labour (wages and salaries and self-employed income), and returns to capital (including interest, depreciation and profits). It also includes all direct and indirect taxes. Regional income is the same concept as regional value added and regional GDP. They are all equivalent to the returns to labour and capital.

The potential for the proposed oyster farm area of 765 ha is to generate directly $25 million of regional income (including $15 million of wages and salaries), and 513 jobs. Multiplier effects increase the total impacts to $41 million of regional income (including $23 million of household income) and 712 FTE jobs. However, this is projected income. There are a range of factors that could impact on the realisation of this potential. These figures are only to be used as an indication of what could be possible in the future in terms of the economic impacts of oyster farming.

4.1.2 Shell Fish Processing Survey

Response Rate and Variability

Of the four processors in Northland, none provided useable data. The estimates of economic impacts used in the report are based on responses made to an earlier Auckland survey (to which three processors replied). One processed oysters, one processed mussels and one had combined oyster farming and processing operation and was not able to give a firm figure for the price at which oysters transferred between the two operations. A price per dozen oysters was revealed from the farmer survey ($2.70) and used in the analysis.

Employment

The number of FTE jobs varied from 4.5 to 8.4 FTEs / $1 million of sales (output), and averaged 5.6 FTEs / $1 million. It was interesting to note that the lower employment rate was associated with the lower value per unit product (mussels).

Household Income

The average income was $30,000 / FTE direct wages and salaries were 17% of output value.

Value Added

Direct value added (which includes wages and salaries) was 37% of output.

Direct and Total Economic Impacts of Oyster Processing in Northland

The expenditure patterns of the respondents were incorporated into the Northland regional input–output model developed for this project. Assumptions were made about the origin of major items[30]. In particular it was assumed that packaging was imported, and that freight was 50% local and 50% out-of region (including international freight). In

[30] Based on a 2005-06 national model (*Stroombergen and Nana 2008)*, and modified to take account of regional self-sufficiency and purchasing patterns reported by respondents.

addition purchases of shellfish were treated as an import to avoid double-counting of the economic impacts of aquaculture, (which had already been calculated separately).

Multipliers were calculated and applied to the direct economic impacts described above; to give total economic impacts per ha of productive oyster farms in Northland. The vast majority of the multiplier effects arose from household spending, because wages and salaries were almost 60% of respondent's total operating expenditure within the region.

The processing economic impacts per $1 million of output were converted to impacts per $1 million of shellfish inputs, using the survey data, which suggested that shellfish inputs were equivalent to 36% of the value of output. The processing impacts were then further converted to economic impacts per ha of productive oyster farm, using the $53,000 / ha output revealed by the oyster farming survey. Finally, these impacts were rated up to economic impacts for the total 313 ha of productive space in Northland (see Table 3). On the basis of the answers received in the questionnaires, 50% is expected to be processed in Northland[31].

The results suggest that direct regional impacts associated with processing the output of 1 ha of productive oyster farm is $150,000. Associated with this is $55,000 of regional business and household income (commonly called value added – analogous to regional GDP), which includes $26,000 of household income, and 0.8 FTE jobs.

[31] This may grow as industry becomes increasingly established and expands further.

Table 3 Direct Impacts, Multiplier and Total Impacts of Oyster Processing in Northland

	Per $1million of fish inputs	Per ha of developed farm (50% processing in Northland)	All Northland Productive Area (50% of 313 ha)	All Northland Potential Area (50% of 150 ha)	Hypothetical area (50% of 765 ha)	Total
Direct Impacts						
Regional Output	$2,800,000 / yr	$75,000 / yr	$24 m / yr	$12 m / yr	$58 m / yr	$94 m / yr
Employment	16 FTEs	0.4 FTEs	126 FTEs	101 FTEs	306 FTEs	533 FTEs
Household Income	$480,000 / yr	$13,000 / yr	$4 m / yr	$2 m / yr	$10 m / yr	$16 m / yr
Regional Income (Value Added)	$1,040,000 / yr	$27,500 / yr	$9 m / yr	$4 m / yr	$21 M / yr	$34 m / yr
Multipliers						
Regional Output	1.33					
Employment	1.31					
Household Income	1.52					
Regional Income (Value Added)	1.45					
Total Impacts						
Regional Output		$100,000 / yr	$32 m / yr	$15 m / yr	$77 m / yr	$124 m / yr
Employment		0.55 FTEs	173 FTEs	83 FTEs	421 FTEs	677 FTEs
Household Income		$19,500 / yr	$6 m / yr	$3 m / yr	$15 m / yr	$24 m / yr
Regional Income (Value Added)		$40,000 / yr	$13 m / yr	$6 m / yr	$31 m / yr	$50 m / yr

Note: Results are rounded to avoid spurious accuracy.

Given that Northland has 313 ha of productive water space, then there is the potential for oyster processing to generate directly $9 million of regional income (including $4 million of wages and salaries), and 126 jobs. Multiplier effects increase the total impacts to $13 million of regional income (including $6 million of household income) and 173 FTE jobs (Table 3).

The potential for the 150 ha of as yet undeveloped oyster consented area is to generate directly $4 million of regional income (including $2 million of wages and salaries), and 101 FTE jobs. Multiplier effects increase the total economic impacts to $6 million of regional income (including $3 million of household income) and 83 FTE jobs (Table 3).

The processing potential for the hypothetical additional oyster farm area of 765 ha is to generate directly $21 million of regional income (including $10 million of wages and salaries), and 306 jobs. Multiplier effects increase the total impacts to $31 million of regional income (including $15 million of household income) and 421 FTE jobs (Table 3).

These figures are only to be used as an indication of what could be possible in the future in terms of oyster processing.

4.1.3 Other considerations

There are many variables that may affect income from year to year, the most significant being harvesting closures due to water quality issues. Based on data provided by the New Zealand Food Safety Authority (NZFSA) for the season Nov08-Oct09, most farms have been closed several times a year, for several days at a time due to excess rainfall. Excessive rainfall is the main reason for farm closures - it increases run-offs to marine farms increasing the level of bacteria absorbed by filter feeders such as oysters. Closures can amount to up to three months of closure for a typical year. Another reason for closure was the presence of biotoxins, but this rarely exceeded 10 days within a given year. Sewerage spills close the odd farm for around 4-8 weeks.

If farms need to close for extended periods of time this prevents them from harvesting. Therefore revenue can be affected. It is not only the total closure time that matters, but also the time in the year when farms are forced to close. For example, if an event happens in summer leading up to Christmas, then this will have a much greater impact than if it were to happen in the middle of the year.

However, the majority of the expenses incurred on the farm are fixed costs and these will occur regardless of the closure of the farm. Although no conclusions can be drawn based on only one sample year (2008-9), it is assumed that any closures which could majorly affect revenue has been reflected through the questionnaire responses and therefore reflected in the EIA.

There are a range of other variables that may affect income such as the value of the New Zealand $, levies/charges (e.g. coastal occupation charges), marine pests, the proposed bond system and costs of resource consents, which some farmers believe, may render their operations uneconomic[32].

[32] Feedback received from the survey questionnaires.

4.2 Hypothetical kingfish aquaculture production

4.2.1 Hypothetical kingfish space and production

The size of commercially viable Kingfish farms is based on individual production units. In general, each farm unit consists of approximately 2 ha of cages and produces between 1,500 to 5,000 tonnes per production cycle (2 years). In this case, it was assumed that each farm unit represents a 2,500 tonne farm[33]. Depending on the depth, bottom type, current and wave exposure, and species farmed, each site needs 10 - 20 ha of consented space to within which cages can be rotated[34]. An additional precaution is farm separation - for biosecurity reasons in the event that commercially significant pathogens or parasite infections develop. Taking these factors into consideration, the following hypothetical consented areas for finfish have been suggested:[35]

- Mid Hokianga Harbour - 20 ha representing one farm
- Henry Island - 10 ha, one farm
- Te Ngaire - 40 ha, two farms
- Kaipara Harbour (Northland region) - 80 ha, 4 farms
- Stephenson's Island 40 ha, two farms

Based on the above 190 ha of consented space, this amounts to a total of 10 farms units[36]. All ten farms are assumed to produce a total of 25,000 tonnes of finfish over two years (or 12,500 tonnes annually).

This level of production would require a minimum of 10 million fingerlings[37]. In order to minimise biosecurity risk, several commercial hatcheries would need to be established in the region. New Zealand does not currently have the capacity to produce fingerlings in such quantities and full production is expected to still be a number of years away in the future.

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[33] A farm unit represents 10 - 20 ha of seafloor area including 2 ha of cages and producing 2,500 tonnes per cycle (equivalent to 1,250 tonnes per year).

[34] The seabed underneath fin fish farms is subject to the accumulation of material – mainly faeces. The idea is to periodically move the cage so the area under the farm can recover.

[35] Support on scientific information was provided to NRC by Andrew Forsythe, NIWA.

[36] The final number of farms will depend on any opportunities for separation.

[37] Conversation with Andrew Forsythe, NIWA, 24th November 2009.

4.2.2 Finfish Farming Survey Data

Data Sources

NIWA has developed a financial model for fish farming in Northland for a project undertaken on behalf of Enterprise Northland[38]. However, due to confidentiality issues this data was not able to be used for the modeling purposes.

The report "Commercial Opportunities for Kingfish Aquaculture in Northland" (NIWA 2003) provides almost no information on the economics of fish farming, beyond saying that a 4 ha farm with a production cycle of 12 – 18 months would, over a 5 year development period, sell 2,815 tonnes of the 3,373 tonnes produced from 1.8M fingerlings. The same farm would make a net return of $2.5 m with a 37 % return on investment (whether this is over the 5 years or per annum is not specified). Employment was forecast to grow from 2 FTEs in year 1 to 15 FTEs in year 5.

The paper "Finfish Culture in Wilson's Bay[39]: A Bio-Economic Analysis" (NIWA, 2008) provided more financial information, but little detail. This report was pessimistic for a small site, and predicted that on a 5 ha site with 1 ha of surface structure, production of 1,300 tonnes per 24 month production cycle would not produce a commercial return. However, a dual 5 ha site, totalling 10 ha, with optimised production could produce up to 2,000 tonnes per year, and by year 5 could be generating EBIT (earnings before interest and taxes[40]) of $7m / year on sales of $17m per year and an annual profit margin of 41 %. Assumptions included:

- Fish sold at $8 / kg (3 kg / fish);
- Harvest at 18 months and then 6 month fallow to allow benthic recovery;
- Output of 650 – 1,000 tonnes / 5 ha site / year
- Feed purchased at $2 / kg (increasing 2% / annum);
- Fingerlings are purchase at $2.40 - $4.00 each (economies of scale in production) and 15 % mortality prior to harvest.

[38] Northland's economic development agency
[39] Firth of Thames.
[40] EBIT is the operating revenue after having subtracted operating expenses, depreciation, and amortisation, but before subtracting charges for interest payments and taxes.

A single 5 ha site requires 10 staff; the dual 10 ha site requires 14 staff, including office and management staff. All other services including site installation, net management, diver services, feed transport, waste management, fingerling transport, harvest services, harvest transport and processing are purchased on a contract basis.

A number of scenarios are developed, but no detailed information on expenditure breakdown is provided. The scenario information reported for each year is simply: sales, production expenses, overheads, EBIT[41]

Models Used

There is currently no finfish farming in Northland. Data was supplied on a confidential basis for a combined farming, processing and selling operation, and this was compared with confidential information associated with a stand-alone fish farm.

To estimate the economic impacts of stand-alone fish farming we have used confidential data based on production of 2,500 tonnes per farm unit[42]. To estimate the impacts of a vertically integrated fish farming and processing operation we have used confidential data which we have scaled to a 10 - 20 ha site based on the 2,500 tonnes referred to above. Economic impacts for the ten farm units were then estimated.

Confidentiality agreements require that we do not report direct effects, and report only total impacts. However, multipliers are generally in the range 1.15 to 1.5. Multipliers were calculated and applied to the direct economic impacts described above; to give total economic impacts per ha of developed finfish farm in Northland. Major assumptions were that neither feed nor fingerlings would be produced within the region.

Total Regional Employment

For pure fish production with all net maintenance, harvesting, processing and selling contracted out, total regional employment is expected to be approximately 20 FTEs / farm unit (including multiplier effects). For an integrated operation including farming, processing and sales, total regional employment is expected to be about 100 FTEs / farm unit.

[41] Earnings before interest and tax, after depreciation.

[42] A farm unit represents 10 - 20 ha of seafloor area including 2 ha of cages and producing 2,500 tonnes per cycle (equivalent to 1,250 tonnes per year).

Total Regional Output

Total regional output associated with a farm unit is estimated to be $10 million / year. Output of a farm and vertically integrated processing and marketing operation is expected to be $23 million / year (Table 4).

Total Regional Income[43]

Total regional income (business and household income) associated with a farm unit is estimated at $4.3 million / year. Value added by a farm and vertically integrated processing and marketing operation is expected to be $10 million / year (Table 4).

Total Regional Household Income

Total regional household income associated with a farm unit is estimated to be $0.9 million / year. Total regional household income associated with a farm unit and vertically integrated processing and marketing operation is expected to be $5 million / year (Table 4). Average income is expected to be $44,000 / FTE in farming, and $53,000 / FTE in the vertically integrated farming and processing operation.

Table 4 Total Impacts of Finfish Farming in Northland including multipliers

	Farming only per farm unit	Farming, processing and selling (vertically integrated) per farm unit	Farming only per suite of hypothetical areas	Farming, processing and selling (vertically integrated) - suite of hypothetical areas
Total Impacts				
Regional Output[44]	$10 m / yr	$23 m / yr	$100 m / yr	$230 m / yr
Employment	20 FTEs	100 FTEs	200 FTEs	1,000 FTEs
Household Income	$0.9 m / yr	$5 m / yr	$9 m / yr	$50 m / yr
Regional Income (Value Added)[45]	$4.3 m / yr	$10 m / yr	$43 m / yr	$100 m / yr

The potential for the suite of hypothetical areas, with a vertically integrated processing and marketing operation, is to generate total impacts of $100 million of regional income (including $50 million of household income) and 1,000 FTE jobs. Output would average $230 million / year.

[43] Commonly called "value added" – analogous to regional GDP.

[44] Output is the value of sales by a business. In the case of wholesale and retail trade, it is the total value of turnover (and not simply gross margins).

[45] Value-Added includes returns to labour (wages and salaries and self-employed income), and returns to capital (including interest, depreciation and profits). It also includes all direct and indirect taxes.

The economic impacts of finfish production would be even greater if fingerlings and feed were produced within the region. They would become more viable once the industry has reached sufficient size. However, there is currently too much uncertainty about these outcomes; therefore associated figures were excluded from the analysis.

What is notable is how large the impacts are per ha of developed water space compared to oyster farming. Total regional income (value added) per ha of oyster farm structure is $54,000, rising to $94,000 when processing is included[46], while total regional income per ha of fish farm structure is $2.15 million, rising to $5.0 million when processing and marketing is included.

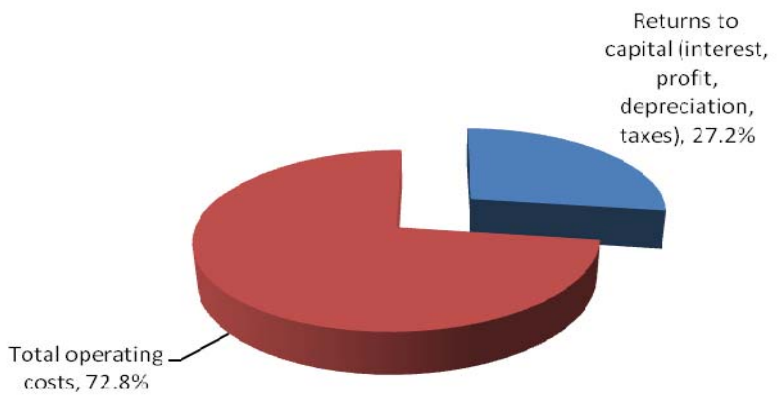
4.3 Case studies

The aim of the project was to undertake a more detailed case study of two marine farms – a remote oyster operation (<5 ha), and a large operation (>10 ha). The idea was that the case studies could be used to highlight the make-up of costs and revenues over two years and aim to inform readers on how marine farm costs and benefits are structured. However, none of the respondents were prepared to allow their data to be used for this purpose. In addition, the farms surveyed showed a wide variability in parameters measured, such as yield, employment and household income.

In order to provide an understanding of how revenues and costs are distributed, the proportion of operational costs and return to capital of total revenue, and the proportion of annual operating costs, categories of total revenue were calculated. The following graph shows that returns to capital of total revenue consist of 27.2%, whereas total operating costs amount to 72.8%.

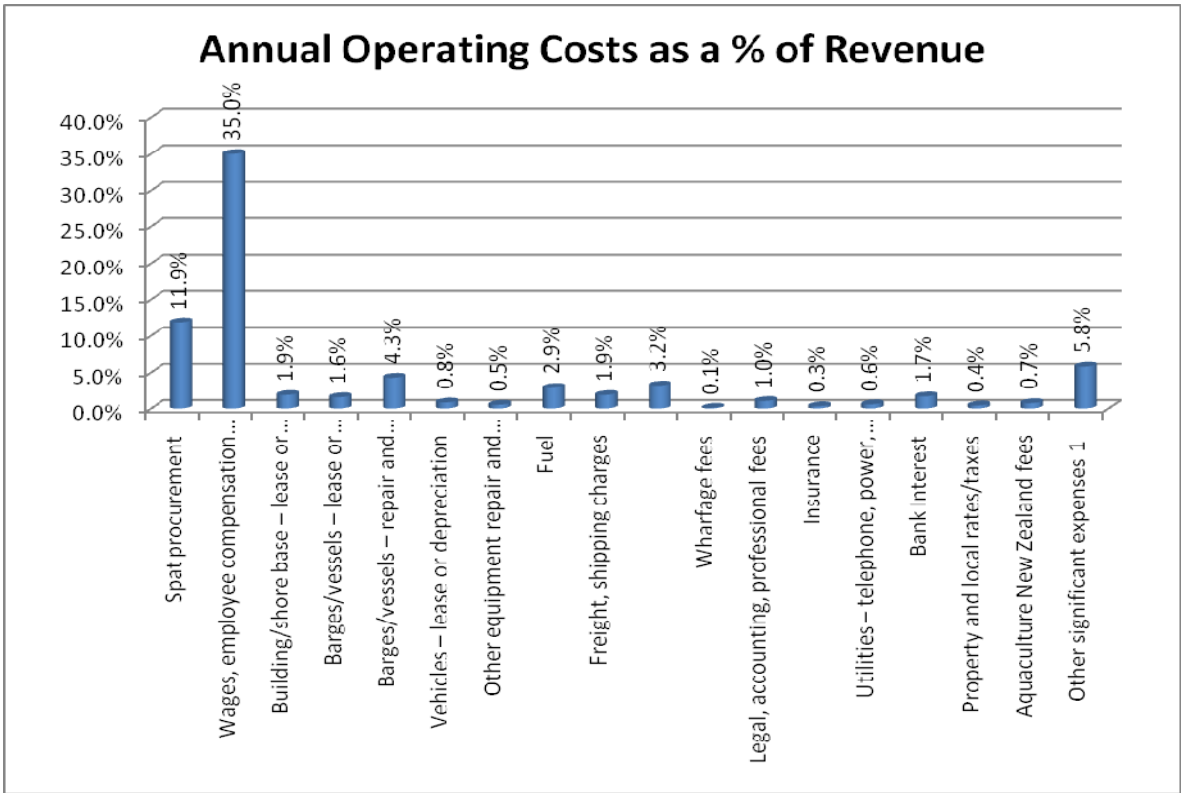
[46] Based on 50% processing in Northland.

Graph 2 Proportion of operating costs and returns to capital compared of revenue



Graph 3 shows that, for combined revenues of just under $1 m from the several questionnaire respondents, annual operating costs typically consisted of 74.5% of revenue. The most significant component of operating costs was wages (35%), followed by spat procurement (11.9%). This data does not represent a typical structure of a farm in Northland, but rather has to be seen as an average example of the farms surveyed.

Graph 3 Proportion of operational costs compared to revenue



4.4 Potential contribution to the national industry

The aquaculture industry's goal is for aquaculture to reach $1 billion in sales (output) per year by 2025. Northland's aquaculture potential is significant. If all the existing, productive potential and hypothetical space (765 ha oysters, 190 ha finfish) were developed, the farming and the associated processing has the potential to contribute an estimated $407 million[47] to the national goal of $1 billion in sales (output) by 2025.

[47] Made up of:

- The direct output from farming and processing of 1228 ha of oyster farms (existing and hypothetical) is $254 million.
- The direct output from the 10 units of kingfish farming is estimated to be $153 million. This is inferred from the estimated output from the 10 kingfish farming units of $230 million (including multiplier) divided by 1.5 (a conservative estimate of the multiplier).

5 Conclusions

The EIA allowed the calculation of the economic impacts of oyster farming (existing, potential and hypothetical) and finfish farming (hypothetical).

5.1 Oyster farming and processing

Table 5 shows the direct and total economic impacts of oyster farming and processing.

Table 5 Economic impact of oyster farming and processing in Northland

Economic Impacts	Oyster Farming			Oyster Processing		
	All Northland Productive Area (313 ha)	All Northland Potential Area (150 ha)	Additional hypothetical Consented Area (765 ha)	All Northland Productive Area (50% of 313 ha)	All Northland Potential Area (50% of 150 ha)	Additional hypothetical Area (50% of 765 ha)
Direct Impacts						
Regional Output	$17 m / yr	$8 m / yr	$41 m / yr	$24 m / yr	$12 m / yr	$58 m / y
Employment	210 FTEs	100 FTEs	513 FTEs	126 FTEs	101 FTEs	306 FTEs
Household Income	$6 m / yr	$3 m / yr	$15 m / yr	$4 m / yr	$2 m / yr	$10 m / yr
Regional Income (Value Added)	$10 m / yr	$5 m / yr	$25 m / yr	$9 m / yr	$4 m / yr	$21 M / yr
Multipliers						
Regional Output	1.76			1.33		
Employment	1.38			1.31		
Household Income	1.60			1.52		
Regional Income (Value Added)	1.62			1.45		
Total Impacts						
Regional Output	$30 m / yr	$14 m / yr	$72 m / yr	$32 m / yr	$15 m / yr	$77 m / yr
Employment	292 FTEs	140 FTEs	712 FTEs	173 FTEs	83 FTEs	421 FTEs
Household Income	$9 m / yr	$5 m / yr	$23 m / yr	$6 m / yr	$3 m / yr	$15 m / yr
Regional Income (Value Added)	$17 m / yr	$8 m / yr	$41 m / yr	$13 m / yr	$6 m / yr	$31 m / yr

- Combined oyster farming and processing from the existing productive 313 ha is estimated to directly contribute $19 million to regional income and create 336 FTE jobs. Multiplier effects increase total economic impacts to $30 million of regional income and 465 FTE jobs.
- Combined oyster farming and processing from the 150 ha (consented area which has the potential to be still developed) has the potential to directly contribute $9 million to regional income and create 201 FTE jobs. Multiplier effects increase total economic impacts to $14 million of regional income and 223 FTE jobs.

- Combined oyster farming and processing from the hypothetical area of 765 ha have the potential to directly contribute $46 million to regional income and create 819 FTE jobs. Multiplier effects increase total economic impacts to $72 million of regional income and 1,133 FTE jobs.

5.2 Kingfish farming

The table below shows the total economic impacts for Kingfish farming.

Table 6 Total economic impacts of kingfish farm units

	Farming Only per farm unit	Farming, Processing and Selling (vertically integrated) per farm unit	Farming Only per suite of hypothetical areas	Farming, Processing and Selling (vertically integrated) suite of hypothetical areas
Total Impacts				
Regional Output[48]	$10 m / yr	$23 m / yr	$100 m / yr	$230 m / yr
Employment	20 FTEs	100 FTEs	200 FTEs	1,000 FTEs
Household Income	$0.9 m / yr	$5 m / yr	$9 m / yr	$50 m / yr
Regional Income (Value Added)[49]	$4.3 m / yr	$10 m / yr	$43 m / yr	$100 m / yr

The potential for the suite of hypothetical kingfish farming areas, with a vertically integrated processing and marketing operation, is to generate total impacts of $100 million of regional income and 1,000 FTE jobs.

5.3 Other

- What is notable is how large the impacts are per ha of developed water space compared to oyster farming. Total regional income (value added) per ha of oyster farm structure is $54,000, rising to $94,000 when processing is included[50], while total regional income per ha of fish farm structure is $2.15 million, rising to $5.0 million when processing and marketing is included.
- Out of the total consented area for mussel farming (43 ha), only 24 ha have been developed. Given this small area, the value of mussel farming to the Northland economy is estimated to be minor.

[48] Output is the value of sales by a business. It is the total value of turnover (and not simply gross margins).
[49] Value-Added includes returns to labour (wages and salaries and self-employed income), and returns to capital (including interest, depreciation and profits). It also includes all direct and indirect taxes.
[50] Based on 50% processing in Northland.

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Appendix One

Hypothetical Developed Sites

Location	Area and type
Kaipara Harbour (Northland region)	400 ha (oysters)
Te Puna Inlet	25 ha (oyster)
North Parengrenga	100 ha (oysters)
Hokianga Harbour	200 ha (oysters)
Whangape Harbour	20 ha (oysters)
Herekino Harbour	20 ha (oysters)
Mid Hokianga Harbour	20 ha (finfish)
Henry Island	10 ha (finfish)
Te Ngaire	40 ha (finfish)
Kaipara Harbour (Northland region)	80 ha (finfish)
Stephenson's Island	60 ha (finfish)

Appendix Two

Request for Economic Data from Aquaculture Operators in the Northland Region

Enveco has been commissioned by the Northland Regional Council to evaluate the contribution of aquaculture to Northland's economy[51].

We are writing to request information on the economic data of your farm[52].

If you are a marine farmer, please fill out part A (2 pages)
If you only process marine farm products, please fill out part B (2 pages)
If you both farm and process, please fill out part C (2 pages)

Please post your responses to: Enveco, 10 Fend Street, Chartwell, Hamilton 3210
For further information, contact Annabelle Giorgetti on 07 855 4059 or 021 2076190
If you like to fill out the form online, please upload the form on www.nrc.govt.nz/aquaculturesurvey and email your responses to annabelle@enveco.co.nz

There are two steps involved in the economic impact assessment:

1. The first is finding out what the Northland aquaculture industry purchases from other sectors in the Northland economy (including capital expenditure on boats, buildings and other equipment; running costs & wages, administrative costs for services etc).

2. The second component is finding out where output/produce goes to – how much is consumed directly, processed or exported.

The survey requires quite detailed information on private business activities and cost structures. This data will be collected for the sole purpose of carrying out an economic impact assessment, and will be used for no other purpose by Enveco. Confidentiality of data will be ensured by aggregating individualised data into an average cost structure for the Northland aquaculture industry as a whole, & reporting only the industry average data.

Enveco is happy to sign confidentiality agreements with individual operators if that is required (please see page 8). At no point will data on an individual business be published, nor will detailed information relating to businesses be discernible.

Thank you for your cooperation – Enveco appreciates your time and effort to participate in this survey. Without your input, the EIA is not feasible.

[51] We're using a modeling technique called Economic Impact Assessment (EIA). An EIA model analyses the flow of money between sectors within the (regional) economy, to understand and evaluate the total supply chain impacts of a particular sector on the entire regional economy.

[52] The Questionnaire has been adapted from the Auckland Regional Council's EIA and PwC 'Economic Assessment of Aquaculture General Methodology', November 2006.

Aquaculture Survey for the Northland Region

A. Aquaculture Grower/Farmer

Name: (company/farmer) _____

Farm Size (ha) _____

Species farmed:	*Annual Harvest Tonnage*	*Farmed Ha (developed not consented)*
Mussels	_____	_____
Oysters	_____	_____

1. Activity conducted in the last year, and in/from which region/location *(please indicate %)*

	Northland Region %	Elsewhere %	**Total %**
Spat collection			
Growing and Farming			
Harvesting			
Packaging			

2. Employment on Farm

	Total No. of employees	No. of employees living in **Northland** Region	Months per year worked
Full time year round			12
Part time year round			12
Full time seasonal			
Part time seasonal			

3. Destination of Output

What proportion of your output goes to processing in Northland? ____%

4. Annual Revenue

If possible show figures for Northland only

Total Revenue (for all aquaculture business activities) $_____

Total annual gross profit (before tax): $_____

If only national figures are known, what proportion of revenue relates to production in Northland? _____**%**

5. Annual Operating Costs for Farming Activities in Northland

Please indicate $ for Northland only, if unknown, please state %.

	Annual operating cost ($ / %)	Please specify the % purchased from a supplier / agent in Northland. (%)	Please specify whether the input was manufactured within Northland. (Y/N)
Spat procurement			
Wages, employee compensation (e.g. bonus, kiwisaver)			n/a
Employee benefits (e.g. vehicles or other, please specify)			n/a
Building/shore base – lease or depreciation			
Barges/vessels – lease or depreciation			
Barges/harvesting contracting fees			
Barges/vessels – repair and maintenance			
Ropes, floats & anchors – depreciation			
Cotton stockings			
Vehicles – lease or depreciation			n/a
Other equipment repair and maintenance (please specify)			
Fuel			
Freight, shipping charges			
Water quality and administration fee			
Wharfage fees			
Legal, accounting, professional fees			
Insurance			
Utilities – telephone, power, internet etc			
Bank Interest			
Property and local rates/taxes			
Consent Application			
Aquaculture New Zealand fees			
Other significant expenses 1 - (if any, please specify)			
Other significant expenses 2 - (if any, please specify)			
Other significant expenses 3 - (if any, please specify)			
Other significant expenses 4 (if any, please specify)			
Total Annual Operating Costs	**$**		

6. Future development

Do you have plans or aspirations to develop your business over the next 10-15 years? Please detail.

_____

_____

_____

_____

Aquaculture Survey for the Northland Region

B. Processing Activities

Name of Company……

Main Products/activities……

1. Employment

	No. of employees	No. of employees living in Northland Region	Months per year worked
Full time year round			12
Part time year round			12
Full time seasonal			
Part time seasonal			

2. Which markets do you sell your products into? *(Please state relative proportions – % of sales/$ value of sales)*

	Northland Region % $	Elsewhere in New Zealand (Please state location). % $	Exported Offshore % $
Seafood wholesaler			
Shop/supermarket			
Cafes/Restaurants			
Direct to households (e.g. at food stalls, farmer's markets, own café/restaurant etc)			
Direct export markets			
Other market (please specify)…….			
Total (*Total of all sales should equal 100%)*			

3. Annual Revenue

If possible show figures for Northland only

Total Revenue (sales from processing operation): **$**_____
Total Annual Gross Profit (before tax): **$**_____
If only national figures are known, what proportion of revenue relates to production in Northland? _____**%**

4. Proportion of fish stocks purchased in last year (if more than one product)?

	Annual Tonnage	Dollar Value $	Proportion purchased from Northland Region	Proportion purchased from other region
Mussels				
Oysters				
Other farmed stock (please specify)				
Non-farmed fish (no need to specify region purchased from)				

5. Annual Operating Costs for Processing Activities in Northland

Please indicate $ for Northland only, if unknown, please state %.

	Annual operating costs ($ / %)	Please specify the % purchased from a supplier / agent in Northland. (%)	Please specify whether the input was manufactured within Northland. (Y/N)
Total Fish Purchases			
Wages, employee compensation (e.g. bonus, kiwisaver)			n/a
Employee benefits (e.g. vehicles or other, please specify)			n/a
Building - lease or depreciation			
Vehicles – lease or depreciation			
Vehicles - maintenance			
Fuel			
Plant and machinery (lease or depreciation)			
Plant and machinery – repair & maintenance			
Containers and packaging			n/a
Warehousing/cold storage costs			
Office Supplies			
Other Supplies			
Advertising and Marketing			
Industry Levies			
Legal, accounting, professional fees			
Insurance			
Utilities – telephone, power, internet etc			
Interest (mortgage etc)			
Property and local rates/taxes			
Other significant expenses 1 (please specify)			
Other significant expenses 2 (please specify)			
Other significant expenses 3 (please specify)			
Other significant expenses 4 (please specify)			
Total Annual Operating Costs			

6. Future development

Do you have plans or aspirations to develop your business over the next 10-15 years? If so, please detail.

_____

_____

_____

_____

Aquaculture Survey for the Northland Region

C. Businesses that have farming and processing activities

Name: (company/farmer) _____

Farm Size (ha) _____

1. Farm Details

Species farmed:	*Annual Harvest Tonnage*	*Farmed Ha*
Mussels	_____	_____
Oysters	_____	_____
Other (please specify species) _____		

What proportion of your harvest is:

Processed in your own premises? _____

Sold as unprocessed product? _____

Do you buy in/process any fish from other farms?

If yes, what proportion of all processed product is from bought in stock?

2. Annual Revenue

If possible show figures for Northland only

Total Revenue (sales from processing operation): **$**_____
Total Annual Gross Profit (before tax): **$**_____
If only national figures are known, what proportion of revenue relates to production in Northland? _____**%**

3. Future development

Do you have plans or aspirations to develop your business over the next 10-15 years? If so, please detail.

_____

_____

_____

_____

_____

4. Operational Costs

It is important that you differentiate the costs associated with farming and those associated with processing. If some of the cost items are for both farming and processing, please split the cost between each activity according to your best guess.

Please indicate $ for Northland only, if unknown, please state %.

	Farming ($000)	Processing ($000)
Building/shore base – lease or depreciation		
Barges/vessels – lease or depreciation		
Barges/harvesting contracting fees		
Barges/vessels – repair and maintenance		
Ropes, floats & anchors – depreciation		
Cotton stockings		
Other equipment repair and maintenance (please specify)		
Water quality and administration fee		
Wharfage fees		
Legal, accounting, professional fees		
Insurance		
Utilities – telephone, power, internet etc		
Bank Interest		
Property and local rates/taxes		
Consent Application		
Aquaculture New Zealand fees		
Total Fish Purchases (spat for farming, non farmed for processing)		
Wages, employee compensation (e.g. bonus, kiwisaver)		
Employee benefits (e.g. vehicles or other, please specify)		
Building - lease or depreciation		
Vehicles – lease or depreciation		
Vehicles - maintenance		
Fuel		
Plant and machinery (lease or depreciation)		
Plant and machinery – repair and maintenance		
Containers and packaging		
Warehousing/cold storage costs		
Office Supplies		
Other Supplies		
Advertising and Marketing		
Industry Levies		
Other significant expenses 1 (please specify)		
Other significant expenses 2 (please specify)		
Total Annual Operating Costs		

Aquaculture Survey for the Northland Region

Confidentiality Agreement

It is understood and agreed to that the below identified discloser of confidential information may provide certain information that is and must be kept confidential. To ensure the protection of such information, and to preserve any confidentiality necessary under patent and/or trade secret laws, it is agreed that

1. The Confidential Information to be disclosed can be described as and includes:
Economic technical data and business information relating to aquaculture activities, including any proprietary ideas and inventions, ideas, patentable ideas, trade secrets, drawings and/or illustrations, patent searches, existing and/or contemplated products and services, research and development, production, costs, profit and margin information, finances and financial projections, customers, clients, marketing, and current or future business plans and models, regardless of whether such information is designated as "Confidential Information" at the time of its disclosure.
2. The Recipient (i.e. "Enveco") agrees not to disclose the confidential information obtained from the discloser to anyone unless required to do so by law.
3. This Agreement states the entire agreement between the parties concerning the disclosure of Confidential Information. Any addition or modification to this Agreement must be made in writing and signed by the parties.
4. If any of the provisions of this Agreement are found to be unenforceable, the remainder shall be enforced as fully as possible and the unenforceable provision(s) shall be deemed modified to the limited extent required to permit enforcement of the Agreement as a whole.

WHEREFORE, the parties acknowledge that they have read and understand this Agreement and voluntarily accept the duties and obligations set forth herein.

Recipient of Confidential Information: Enveco
Name (Print or Type): Annabelle Giorgetti
Signature:
Date:
Discloser of Confidential Information:
Name (Print of Type):
Signature:
Date:

Appendix Three

Letter sent out to marine farmers

Please Quote File: 990.3.35

BML:BML

9th October 2009

<to be inserted>

Dear Sir/Madam

Study of the economic impacts of Marine Farming in Northland

Marine farming is an important industry for Northland and a key contributor to our regional economy.

The Northland Regional Council (NRC) is currently looking at ways the Council can help grow Northland's economy and as part of this, is keen to get an accurate, up-to-date picture of the contribution marine farming already makes.

To that end, the NRC has employed the services of Annabelle Giorgetti from Enveco Limited. A big part Annabelle's work will be a survey of all Northland's marine farmers, including asking some questions about the basic financial operations of farms like yours.

We appreciate such information can be commercially sensitive, but in order to ensure the data collected is as accurate as possible, would very much appreciate your participation and co-operation.

We also wish to assure you that although the study will eventually be made public, any information provided by you will not be disclosed in any way that could specifically identify you or your business.

Annabelle will contact you soon.

If you have any questions please feel free to contact Annabelle direct on (07) 855 4059 or via email: annabelle@enveco.co.nz Alternatively, you can contact Ben Lee at the Northland Regional Council on (0800) 002 004 or email him at: benl@nrc.govt.nz

Yours faithfully

Ben Lee
Policy Analyst
Northland Regional Council

Appendix Four

Generation of a Study Area Economic Model

Regional economic models can be generated using a national production function and modifying the input coefficients to reflect average regional self-sufficiency in the various input industries. This approach presumes that input structures for a given industry are the same in different regions. By contrast, the type of analysis undertaken here establishes the input structure (type and origin) of the industries in question (in this case, marine farming industries) in the particular region.

While one can assess aquaculture budgets to determine the nature and location of purchases, this gives only the first round of indirect impacts. To estimate the further impacts caused by the spending of businesses further down the chain, one has the option of surveying all those businesses as well (which is prohibitively expensive), or estimating the probable pattern of their expenditure on the basis of information that already exists about national average expenditure patterns of businesses of this type, and the regional location of businesses that supply those inputs. For example, if we know that one per cent of all marine farm costs are spent on ropes and we know that the region has no factory producing ropes, then we can assume that this one per cent of costs is imported into the region.

All the information and assumptions are incorporated into a separately estimated regional input-output model. This specific regional model is generated using an existing national input-output model, information about the regional distribution of employment and output, and a mathematical technique called GRIT[53] (Generation of Regional Input-output Tables - which estimates the source of inputs into regional industries). This model is then adjusted by incorporating into it the data that has been gathered about the type and source of purchases by marine farmers in Northland. The input-output model can be used to calculate the total effects on all sectors of an increase in output of any single sector. These total effects include the original effect and all the consequential rounds of indirect and induced effects. Note that it does not include any downstream impacts (see definition of indirect impacts above), which have to be calculated separately.

[53] Developed in Australia and widely used there and in New Zealand. See West et al., (1982), or Butcher (1985).

The regional economic model generated for this study is based on the national inter-industry model for 20005/06.

The GRIT process uses regional output by industry as its starting point. There is limited information currently available on regional output by industry, and Statistics New Zealand will not release highly disaggregated data on the grounds that to do so would breach commercial confidentiality of businesses supplying the data. For the Northland region the most detailed data that are available relates to employment as measured by the census and the annual Business Enterprise survey.

Once the survey information had been incorporated into the regional model, employment, output, value-added and household income multipliers can be estimated for each farming scenario using matrix algebra[54]. Type II multipliers (which include induced effects) were calculated. It is clear that the increased direct household income from marine farming stimulates household spending and hence economic activity in the regional, and for this reason it seems appropriate that Type II multipliers be used to calculate total economic impacts.

[54] Customised software (e.g., IO7- available from the authors) which undertakes the matrix manipulation is readily available. Numerous texts are available which describe general input-output models.