sapere research group

Economic impact of Coromandel aquaculture

Report prepared for the Hauraki-Coromandel Development Group

Sally Wyatt

August 2011

About Sapere Research Group Limited

Sapere Research Group is one of the largest expert consulting firms in Australasia and a leader in provision of independent economic, forensic accounting and public policy services. Sapere provides independent expert testimony, strategic advisory services, data analytics and other advice to Australasia's private sector corporate clients, major law firms, government agencies, and regulatory bodies.

Wellington
Level 9, 1 Willeston St
PO Box 587
Wellington 6140
Ph: +64 4 915 7590
Fax: +64 4 915 7596

Auckland
Level 17, 3-5 Albert St
PO Box 2475
Auckland 1140
Ph: +64 9 913 6240
Fax: +64 9 913 6241

Sydney
Level 14, 68 Pitt St
GPO Box 220
NSW 2001
Ph: + 61 2 9234 0200
Fax : + 61 2 9234 0201

Canberra
Level 6, 39 London Circuit
PO Box 266
Canberra City
ACT 2601
Ph: +61 2 6263 5941
Fax: +61 2 6230 5269

Melbourne
Level 2, 65 Southbank Boulevard
GPO Box 3179
Melbourne, VIC 3001
Ph: + 61 3 9626 4333
Fax: + 61 3 9626 4231

For information on this report please contact:

Name: Sally Wyatt

Telephone: 04 915 5359

Email: swyatt@srgexpert.com

Executive Summary

The aquaculture industry is recognised as an industry with growth potential: the sector aspires to achieve output of $1billion nationally by 2025[1] and in recent years has invested widely in legislative change and research and development. The global aquaculture industry is estimated as one of the world's fastest growing primary industries, with recognition that catching and harvesting seafood needs to be managed to avoid the collapse of wild fish stocks. There is considerable potential for growth in aquaculture exports from New Zealand provided New Zealand producers can continue provide quality products to global markets.

The Coromandel will be one of the areas which benefits from investment in aquaculture. New tracts of marine space will be opening up in the Firth of Thames, the Wilson Bay marine farming zone and within the Coromandel marine farming zone over the next decade. This growth will translate into local-level change. There is a clear appetite for economic growth from aquaculture: aquaculture is identified in the Hauraki-Coromandel Development Group's economic development strategy as a high priority for action, along with other industries such as tourism, transport and storage, minerals/mining, and manufacturing.[2]

Against this backdrop, it is important to understand how the aquaculture industry contributes to the region's economic life. This report was commissioned to estimate the economic impact of marine farming and seafood processing that currently occurs in the Coromandel district. It estimates the impacts on the Waikato region and on New Zealand as a whole. This report also provides an insight into what economic impacts might occur as a result of future expansion of marine farms in the region, including the addition of finfish farms.

Current economic impacts

In the 2010/11 year, farms in the Coromandel district harvested an estimated 31,000 green weight tonnes (GWT) of mussels and half a million dozen oysters. Aquaculture New Zealand estimates that the Coromandel district produces 24 per cent of national mussel production and 20 per cent of oyster production. For that period, processors in the Coromandel district processed about 30 per cent of the volume of mussels harvested while processing facilities in Auckland and Tauranga

[1] New Zealand Aquaculture Council (2006).

[2] Coromandel Peninsula Blueprint – Volume 1 (Page 15).

processed the remainder. Almost all the oysters harvested in the Coromandel were either processed in Coromandel or sold fresh to consumers and wholesalers.

Aquaculture contributed an estimated $31.4 million of value added[3], or regional gross domestic product (GDP), to the Waikato region in 2010/11. This is 0.2 percent of Waikato's total gross regional product (GRP); by comparison dairy farming and dairy factories contribute around 10.8 percent of GRP[4]. The contribution to GDP is comprised of aquaculture farming impacts (approximately 43 percent of total) and aquaculture processing impacts (approximately 57 percent of GDP impact). In terms of employment, there are an estimated 432.3 full time equivalents (FTEs) resulting from aquaculture and its supplying industries located in the Waikato region. These are comprised of 297.4 in direct farming and processing jobs, 72.5 indirect jobs as a result of activity in other industries, and 62.4 induced jobs.

The Coromandel does not support many ancillary services (i.e fuel supply, spat supply, research, marketing, legal services), which means that the economic impact is relatively lower than it is in regions where such ancillary services exist. For this reason, the Coromandel industry's contribution to the national economy should not be overlooked.

When measured for its value to the national economy, the Coromandel aquaculture industry contributes $77.4 million in GDP to the national economy – and generates a total of 1,193full-time equivalent jobs. These results show that Coromandel production generates significant impacts from aquaculture processing in adjoining regions, and from inputs sourced in other regions.

The tables overleaf summarise these results.

[3] Value added or gross domestic product (GDP) is the value of sales minus the value of intermediate goods used in the production of that output. It is one of the most common measures of economic activity.

[4] Source: Waikato Regional Council

Economic impact of the Coromandel aquaculture industry – Waikato Region

2010/11 financial year (NZD_{2010}$)

Waikato region	*Shellfish Farming*	*Shellfish Processing*	*Total Impact*
Output			
Direct	$21.8	$26.2	$48.0
Indirect	$3.9	$9.2	$13.1
Induced	$5.1	$5.8	$10.9
	$30.8	***$41.1***	***$71.9***
Value Added (GDP)			
Direct	$11.8	$7.6	$19.4
Indirect	$1.8	$4.5	$6.3
Induced	$2.7	$3.1	$5.7
	$16.2	***$15.2***	***$31.4***
Gross Household Income			
Direct	$5.4	$5.2	$10.5
Indirect	$1.3	$2.3	$3.6
Induced	$1.2	$1.4	$2.5
	$7.8	***$8.8***	***$16.6***
Employment (FTEs)			
Direct	121.2	176.3	297.4
Indirect	10.5	62.0	72.5
Induced	26.3	36.0	62.4
	158.0	***274.2***	***432.3***

Economic impact of the Coromandel aquaculture industry – National

2010/11 financial year (NZD_{2011}$)

National (total)	*Shellfish Farming*	*Shellfish Processing*	*Total Impact*
Output			
Direct	$21.8	$73.8	$95.6
Indirect	$15.4	$34.8	$50.1
Induced	$11.6	$29.3	$40.9
	$48.8	***$137.9***	***$186.7***
Value Added (GDP)			
Direct	$11.8	$22.4	$34.1
Indirect	$6.4	$16.2	$22.6
Induced	$5.9	$14.9	$20.7
	$24.1	***$53.4***	***$77.4***
Gross Household Income			
Direct	$5.4	$13.6	$18.9
Indirect	$3.8	$9.3	$13.1
Induced	$2.9	$7.4	$10.3
	$12.1	***$30.3***	***$42.4***
Employment (FTEs)			
Direct	121.2	430.0	551.2
Indirect	117.7	259.7	377.4
Induced	75.4	189.5	264.8
	314.2	***879.2***	***1193.4***

This study highlights the relative importance of aquaculture processing in the generation of economic impacts from aquaculture. The processing facilities in the Coromandel district and surrounding regions are dependent on local aquaculture farms, so a symbiotic relationship exists between the farms and processing facilities.

Future growth scenario

This report considers the impact of future aquaculture developments in the Coromandel. Development in this area is highly likely because new marine farming zones have been established as part of recent law reforms and further shellfish farming consents were issued in 2011. Production at a point in the future, 2025, has been chosen because it allows for consideration of the impact of full development of shellfish farms, the introduction of finfish farms and to allow for comparison with the sector strategy[5] and other industry projections[6].

The scenario presented in this report assumes that mussel production from the region has increased to 60,000 green weight tonnes. This estimate takes account of new zones and numerous small farm extensions, namely:

- Full development in Wilson Bay A (additional 70.5 ha becoming operational)
- Full development in Wilson Bay B (520 ha becoming operational)
- Various small extensions and realignments (net additional 50 ha becoming operational)
- BUT Leaving aside the potential conversion of spat space in the Western Firth

The scenario for mussels assumes that the location of mussel processing will continue in Whitianga, Tauranga and Auckland, in roughly the same proportion as currently.

The scenario for oyster production assumes that the hectarage for oysters will remain largely unchanged but that farmers in the region will likely convert production from racks to basket technology. This, alongside widespread selective breeding practises, is expected to double the output of the region's oyster farms by 2025. The scenario also assumes, perhaps optimistically, that disease incursions such as the herpes outbreak experienced earlier this year will not be regular features.

---

[5] New Zealand Aquaculture Council (2006)

[6] For example, NZIER (2010)

This study estimates that the growth in production of mussels and oysters is expected to see the mussel and oyster industry contributing a total of $60.7 million in GDP[7] to the regional economy by 2025, and bringing in 835 full-time jobs (in other words, creating 403 new full-time equivalent jobs across the region). At the national economy level, the Coromandel mussel and oyster industry will generate $149.3 million in GDP by 2025, and generate 2,301 full-time equivalent jobs.

The Government has passed legislation to allow for finfish farming in the Hauraki Gulf and in the new Coromandel Marine Farming Zone. While there is potential to farm a greater volume given approved discharge limits, a conservative estimate is of production of 6,000 tonnes of Kingfish (5,175 tonnes head off, gilled and gutted (HoGG)) from the region by 2025. This will generate an extra $56.3 million of revenue (direct output[8]) per annum for the entity or entities involved in farming and processing fish. The scenario assumes that processing and export of the fish will occur at a facility in the Coromandel district. It further assumes that the farming and processing facilities will be vertically integrated and the bulk of the product will be exported.

This study estimates a contribution of an additional $34.9 million in GDP to the regional economy from finfish farming. Assuming that the finfish processing can be done on the Peninsula (either at the existing fish factory in Whitianga, or at new plants built at Coromandel or Thames), this will create an additional 354.4 full-time equivalent jobs. At the national level, finfish farming in the Coromandel is predicted to bring in an additional $45.6 million in GDP to the New Zealand economy, and create 473.6 new full-time equivalent jobs.

In summary, this study estimates that:

- Aquaculture contributed an estimated $31.4 million of value added, or regional gross domestic product (GDP), to the Waikato region in 2010/11.
- The contribution to GDP is comprised of aquaculture farming impacts (approximately 43 percent of total) and aquaculture processing impacts (approximately 57 percent of GDP impact).

---

[7] While it is likely that economies of scale will be experienced with greater volumes being produced, no economies have been incorporated into the expenditure figures in the future scenario. This is due to the difficulty in estimating these with any accuracy. Nor have changes to wider industry dynamics, such as the location of processing and the mode of transport of goods.

[8] Gross output is the total value of sales before subtracting the value of intermediate goods used in the production of the output. Direct output, or revenue, is generated by entities involved in the farming and processing of products grown on marine farms. In contrast, indirect and induced output is generated by entities involved in other industries.

- In terms of employment, there are an estimated 432.3 full time equivalents (FTEs) resulting from aquaculture and its supplying industries located in the Waikato region.
- The Coromandel aquaculture industry contributes $77.4 million in GDP to the national economy – and generates a total of 1,193 full-time equivalent jobs.
- The combined contribution from mussels, oysters and finfish to the regional economy by 2025 will be $95.6 million in GDP, with the generation of 1,190 full-time equivalent jobs.
- At the national level, the Coromandel industry will contribute $194.9 million in GDP by 2025, and generate a total of 2,775 full-time equivalent jobs.

Where the impacts from growth will be felt

Economic impacts from the increased levels of aquaculture production in the region can be expected to occur in the following areas:

- Supplying industries – industries that supply the farms with intermediate inputs, like suppliers of farm equipment or boats, will benefit. The national fishing industry may end up supplying fish feed to the farms. In addition, facilitating industries like transport and business services will benefit.
- Household expenditure industries – industries that households spend money on will benefit as increased incomes from marine farming are spent in the region. Such industries include housing and real estate and consumption goods like retail trade.
- Investment related industries – There will be impacts, temporary in nature, on the construction sector as farms and accompanying infrastructure like roads, wharves and shore facilities are built.

There will also be negative impacts on some industries if investment expenditure is diverted away from certain types of production and put into aquaculture. Other industries may suffer as resources become increasingly scarce, and thus more expensive. Labour is one example of this. So for example you may see labour being diverted from horticulture or fishing in the region and into aquaculture.

Table of Contents

1 Introduction

1.1 This study

This report describes the impact of Coromandel's aquaculture industry on the Waikato region and more broadly, on New Zealand. The industry in Coromandel is comprised of mussel farming, mussel processing, oyster farming and oyster processing. While there is spat catching and fishing charter operations that use the mussel farms, these activities have been excluded from the study.

The impact is expressed in terms of Output, Value Added (GDP), Gross Household Incomes, and employment.

1.2 Economic impact studies

To understand the role of the aquaculture industry, one needs to understand the dynamics of how the industry functions within the local economy. An economic impact assessment traces spending through an economy and measures the overall effect of that spending on the local economy. Economic impact assessment recognises that one form of economic activity almost always leads to others.

An increase in final demand for any sector has repercussions throughout the whole economy, not just for that one sector. For example, if the demand for aquaculture products increases significantly, the sector (when unconstrained) will respond to this demand, by increasing production. This will require an increase in the inputs to that sector – perhaps more barges, buoys or labour inputs. It may also require an increasing capacity in processing of the product, or in ancillary downstream industries such as neutraceuticals if it is not sold directly. Also, if the increased production leads to higher profits and income, this will be saved, reinvested into the business or spent on consumer goods.

This study uses the Input-Output method, which measures three types of impact:

- Direct impacts which relate to the injections of revenue and expenditure that can be specifically attributed to the aquaculture industry;
- Indirect impacts which arise 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 which arise as a consequence of increases in the level and value of expenditure on goods and services, due to increased household incomes in the study area.

The total economic impact is the sum of these three effects.

The input-output model documents the linkages between industry sectors, showing purchases between sectors. Input-output tables are published intermittently at a national level in New Zealand by Statistics New Zealand. The most recent input-output table relates to 2006-2007, which has been used for this study. There is an assumption that similar patterns of purchase occurred in 2010-2011.

One extension of the input-output methodology is the generation of multipliers. The concept of a multiplier is that it is possible to effectively measure how a particular sector or industry is integrated with the rest of the economy. Multipliers can be seen as a set of simple mathematical relationships between one industry and the rest of the economy, and are used to measure the effects of a change in one industry on the overall economy. Multipliers are based on coefficients derived from the input-output transactions table. There are two types of multiplier:

- Type I multiplier, which captures direct and indirect backward linkages associated with direct expenditures. A type I multiplier measures the direct and indirect effects of an increase in expenditure from the industry; and
- Type II multiplier, which measures the direct, indirect and induced effects, taking into account consumer expenditure in the economy stimulated by the wages and salaries paid to the workers in the aquaculture sector.

Input-output analysis is based on average impacts. It maintains a set of assumptions about constant and uniform proportions of expenditure in the various sectors of the economy.

The multipliers used for this study were prepared by Geoffrey Butcher of Butcher Partners Limited.

The methodology also uses models of 'prototype' farms and processors. Information collected in interviews and from other sources was compiled into the model which generates a set of sample accounts. A distinction is made between businesses that operate within the regional boundary and those that are outside the regional boundary. These sample accounts were then incorporated into the regional economic model to estimate multipliers for the model aquaculture farms and processors.

The methodology used in this study is consistent with the method used by Covec in the 2007 study, and with the Economic Impact Assessment methodology recommended by PricewaterhouseCoopers in the project commissioned by New Zealand Trade and Enterprise, Auckland Regional Council and Environment Waikato to develop a methodology for assessing the economic effects of aquaculture at a regional and sub-regional level.

1.3 Limitations of method

The first limitation of this method is that an economic impact study is a static analysis: a snapshot in a period of time. A limitation with any static analysis is that it

is based on fixed prices and set industry linkages for a fixed time period. It cannot capture dynamics such as changing product or commodity prices, which are relevant to an emerging industry such as aquaculture.

The second limitation is that the figures do not capture opportunity cost. That is, these economic impact figures do not allow for the fact that alternative activities could be carried out using the same resources, ie sea, land, labour and capital. GDP, value-added, household income and employment are important impacts and can provide an indication of the value of economic activity in the region, but they do not indicate what else might have been done with the capital employed. For example, rezoning could allow the farming of finfish instead of shellfish which could impose a different range of financial, social and environmental effects. Depending upon the costs and benefits of this activity relative to the other potential activities, the Waikato Region could be better- or worse-off if existing activities were substituted for alternative land and sea uses.

However, determining whether the existing activity provides a net benefit compared with other possible activities requires a comprehensive cost-benefit analysis. This is outside of the scope of this study.

1.4 Data sources

In order to analyse the economic impact of the aquaculture industry, a number of data sources were used, including:

- A series of interviews of Coromandel's marine farmers and processors of their products, conducted by Ben Dunbar-Smith of the Hauraki-Coromandel Development Group.
- Waikato Regional Council's marine farm database.
- An Auckland Regional Council economic impact study of aquaculture from 2010, by Market Economics Limited.[9]
- An Environment Waikato economic impact study of aquaculture from 2007, by Covec Limited.[10]
- A Northland Regional Council economic impact study of aquaculture from 2010, by Enveco Limited.[11]

[9] Murray, C. and McDonald, G. (2010)

[10] Environment Waikato (2007)

[11] Giorgetti, A. (2010)

- A Ministry of Fisheries report about Kingfish and Hapuku farming from 2010, by NZIER Limited.[12]
- Aquaculture New Zealand's export statistics.
- Statistics New Zealands *Annual Enterprise Survey*.
- Statistics New Zealand's *Harmonised System Classification.*

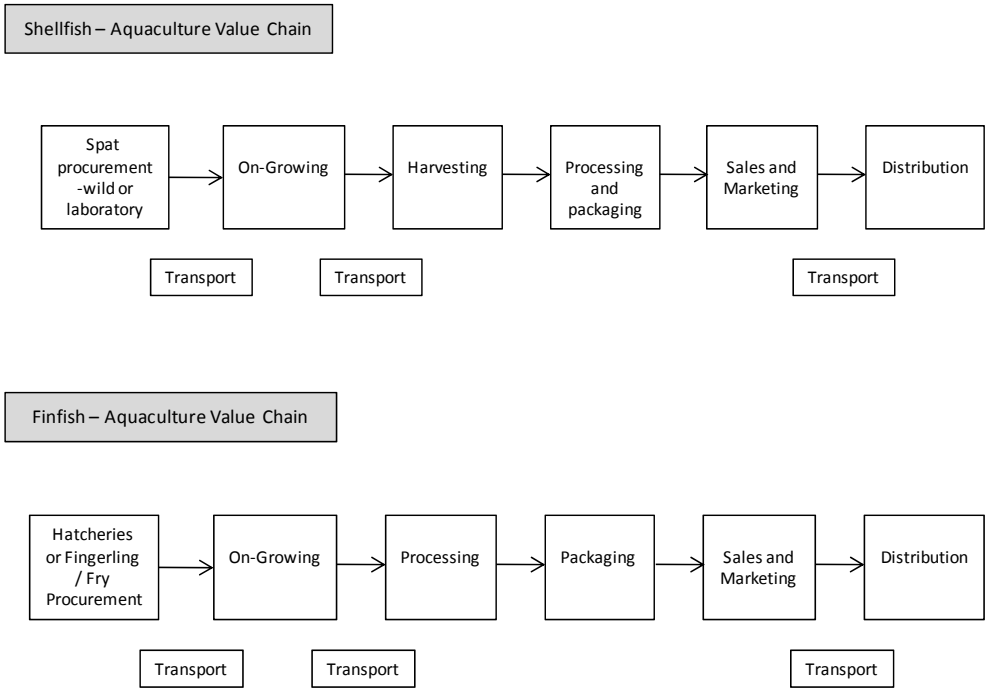
[12] NZIER (2010)

2 Industry background

2.1 Industry overview

The aquaculture industry consists of a value chain starting with suppliers of inputs for marine farms such as spat, ropes and so on, to distributers and exporters or to industries which use aquaculture products in their goods (e.g. neutraceuticals, cafes and restaurants). The aquaculture industry value chain was summarised by PricewaterhouseCoopers (2006) and was described as covering functions 'from seabed to plate'. These functions are illustrated below.

Aquaculture value chain (Source: PricewaterhouseCoopers (2006))



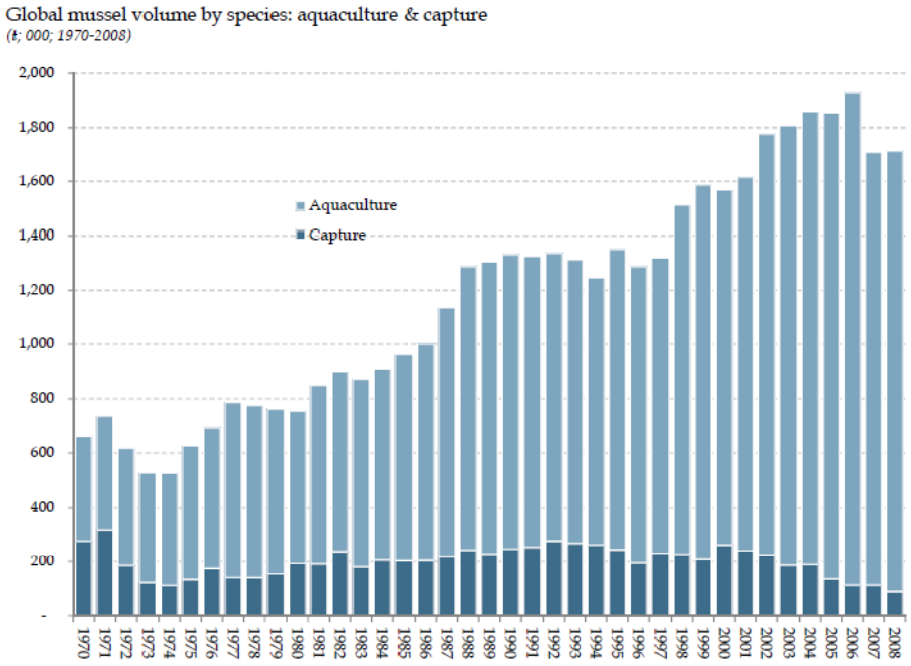
2.2 Global aquaculture

Aquaculture is the fastest growing food production system in the world. For the past 20 years, global production from aquaculture has steadily increased. This trend is projected to continue, especially for low energy intensive farming.

On a global scale, aquaculture is already a major contributor to meeting the needs of world food production, with the UN Food and Agriculture Organisation (FAO) stating that aquaculture now contributes half of the fish consumed by the human

population worldwide[13]. This trend is likely to continue, with increasing world population, exploitation of existing global fisheries, and growing prosperity in Asian countries driving international demand.

Global mussel aquaculture production has grown at a cumulative average growth rate (CAGR) of 2% over the past decade. While New Zealand's production of greenshell mussels plateaued over the past few years, the production of other species of mussels (primarily from Asia) continues to grow.[14]



Source: UN Food and Agriculture Organisation (FAO) "The State of World Fisheries and Aquaculture" 2008

[13] UN Food and Agriculture Organisation "The State of the World Fisheries and Aquaculture" 2008

[14] UN Food and Agriculture Organisation (FAO) FishStat, with analysis from Coriolis Limited (unpublished report)

New Zealand's traditional markets for mussels are the United States, Canada, Europe and Australia[15]. While these traditional markets are still important, particularly Europe where higher returns for products are achieved, the areas of growth in recent years have been Australia and Asia, particularly South East Asia.

Global oyster production has similarly grown, however effectively all growth is coming from increased production in China of the *Crassostrea* product, of which very little is exported. Production of Pacific Oysters from New Zealand has remained fairly flat since the 1980s. New Zealand's exports of Pacific Oysters make up 5 percent of global oyster export value. Sixty three percent (by value) of New Zealand's oysters go to Australia and the Pacific Islands and a further thirty percent go to Asia[16].

New Zealand is the market leader in most of its key markets for Greenshell mussels, Pacific oysters and salmon; no other country stands out as a key global competitor; this implies that to grow exports, New Zealand exporters will need to grow the market. This is not one of their traditional strengths. But if this market penetration can be achieved, it appears that the international demand will be sufficiently strong to support ongoing production growth within New Zealand.

2.3 Mussel exports and export prices

Globally, only 12 percent of the total worldwide mussel production is exported to other countries. New Zealand exports the bulk of its mussels, and as a consequence, exports of New Zealand Greenshell mussels make up 27 percent of global mussel export value.[17] As New Zealand is the only country that produces Greenshell mussels, 100 percent of the exports of Greenshell mussels come from New Zealand.

The price that 'sets the market' for New Zealand exporters tends to be the export price to the United States market, which is dominated by frozen halfshell mussels. Frozen halfshell (HS) mussels make up 77 percent of the value of mussel exports from New Zealand (83 percent by weight)[18].

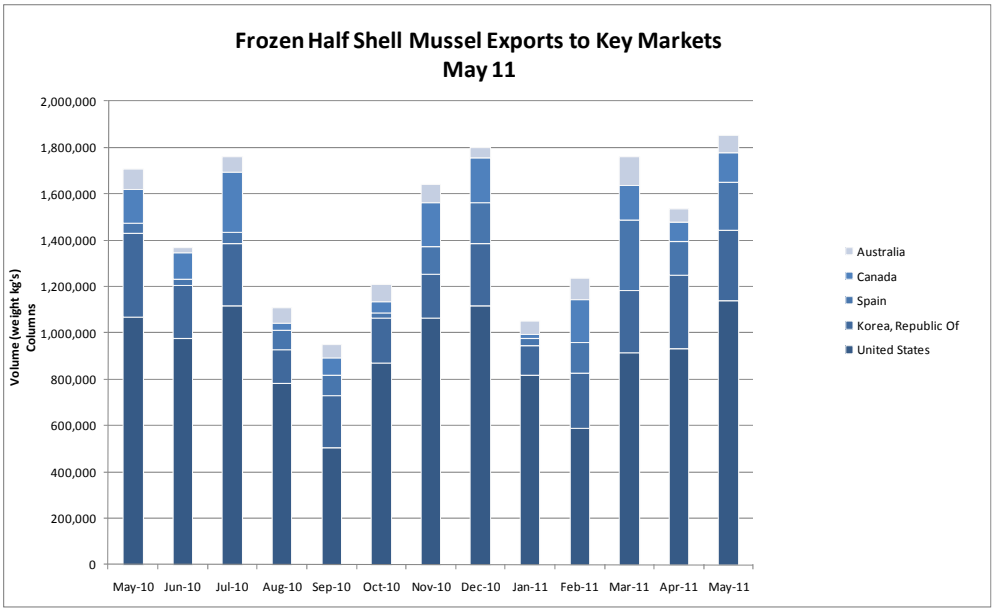
---

[15] Aquaculture New Zealand export database.

[16] Ibid, n.14.

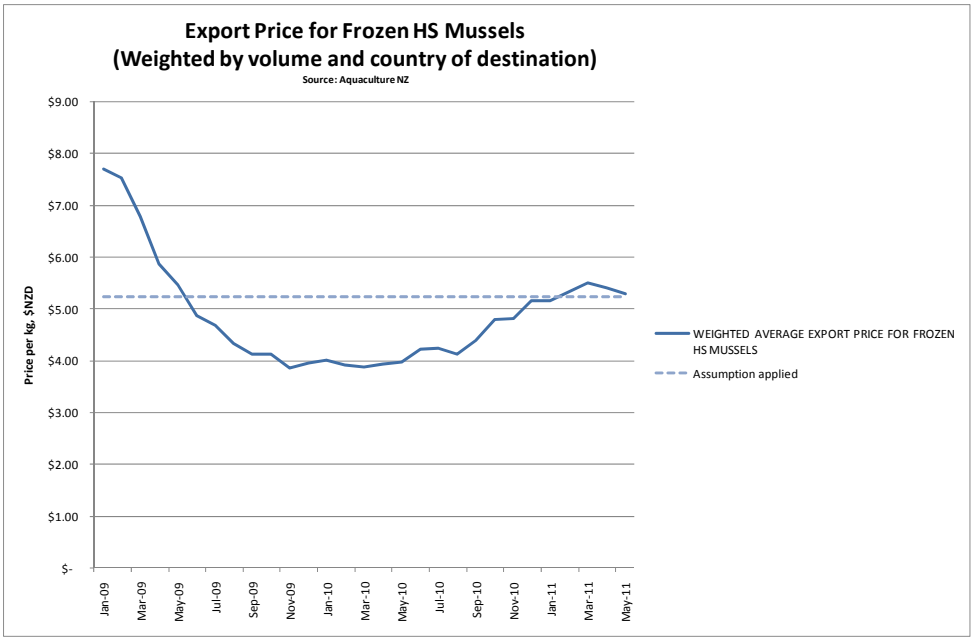
[17] Ibid.

[18] Aquaculture New Zealand export database, statistics for June 2010 – May 2011.



Source: Aquaculture New Zealand export statistics

Export prices for mussels are notoriously volatile, with the main driver for variation being the prevailing exchange rate. In the 2010-11 year, prices fell as low as US$1.75 per pound in October 2010 but had risen back up to US$2.10 by April 2011. According to processors, prices for the 2010/11 season averaged out to US$2.00 – US$2.10. The chart below, which converts mussel prices to New Zealand dollars using the exchange rates for the countries of origin at the time of trade, indicates this variability.



Source: Aquaculture New Zealand, Export Statistics, with Sapere analysis

Not all of the effect of price variability flows through to mussel processors, however. In aquaculture, as in other export driven industries in New Zealand, the domestic market acts as a shock absorber for changes in global price and global demand. If domestic supply for export grows, domestic demand will grow through the domestic market receiving the "export reject" with availability at low prices that will stimulate domestic consumption.

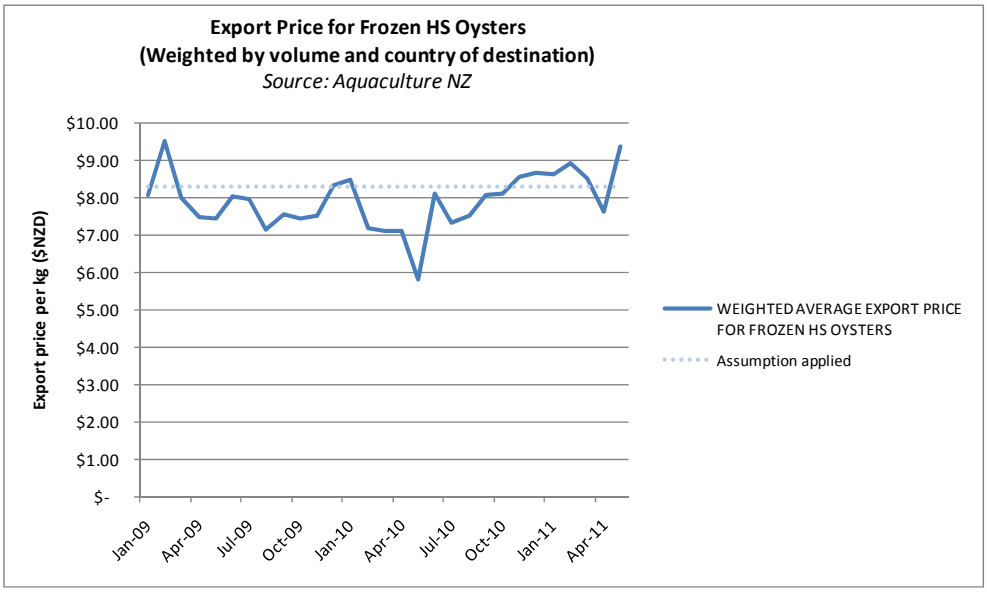
In this study, an assumption of NZD$5.23 per kilo of mussels sold has been applied to all exported product, from all processors of Coromandel mussels. This assumption is shown by the dotted line on the chart above.

2.4 Oyster exports and export prices

In the case of oysters, the price that sets the market tends to be the frozen half shell (HS) price, as product in this form makes up 80 percent of the export value and 78 percent of export weight[19]. Export prices over the past year have increased back from a low in May 2010. On average, the export price for frozen HS oysters in the

[19] Source: Aquaculture New Zealand export database, statistics for June 2010 – May 2011.

year to April 2011 was $8.29 per kg. This average is the assumption applied to all processors of oyster products in this study.



Source: Aquaculture New Zealand, Export Statistics, with Sapere analysis

2.5 New Zealand aquaculture

New Zealand's aquaculture industry was first established in the 1960s and comprises approximately 6,250 hectares of farmed space. Predominately this is taken up by mussel farms (particularly in Marlborough Sounds, Golden Bay and Coromandel), with a significant oyster farming industry (particularly in Northland and Auckland), some areas for scallop growing and a small number of salmon farms. In 2010, aquaculture production in New Zealand was as follows:

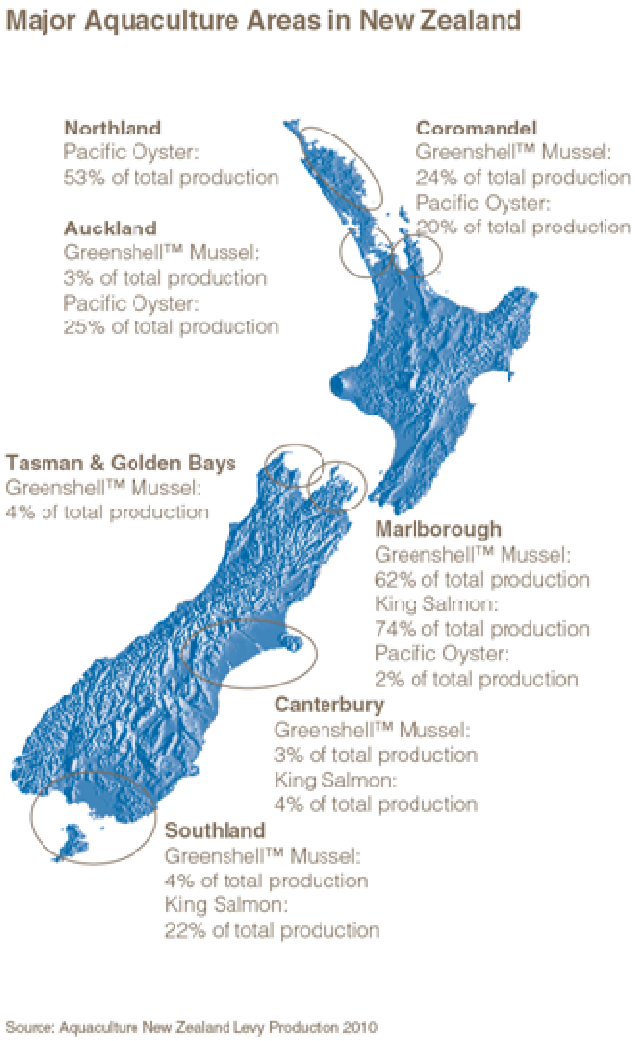
Aquaculture production in New Zealand, 2010

Species	*NZ Greenshell mussels*	*NZ Pacific Oysters*	*NZ King Salmon*	*Paua*
Production	92,000 GWT	2,439 GWT	12,893 GWT	Approx. 10 GWT

Source: Aquaculture New Zealand

Aquaculture makes up approximately 20% of the total fisheries production in value, and 15% of New Zealand's seafood exports by revenue. Approximately two thirds of New Zealand's aquaculture production is exported – and distributed to 77 countries worldwide.[20]

Aquaculture growing areas, 2010



[20] Aquaculture NZ export database.

Research is underway by the industry and research institutions to explore options for farming new species, for example kingfish and hapuka, and to increase the quality and quantity of yields of existing farmed species. The aquaculture industry is recognised as a growth industry with aspirations for the New Zealand aquaculture sector to have sales of $1 billion per annum by 2025.[21]

2.6 Coromandel aquaculture

The Coromandel region is second only to the Marlborough Sounds in the importance of aquaculture – both in terms of the number of farms and the total area farmed. Its advantages are its sheltered waters, accessibility, favourable climate, good water quality and availability of nutrients. The region produces 24% of the mussels harvested in New Zealand and just under 20% of the oyster harvest.[22]

The Coromandel Marine Farmers Association, which represents producers in the region, has approximately thirty members. Amongst this group, there are several larger producers, such as Greenshell NZ, Sanford and Sealord. Most of the remaining members are farmers with smaller holdings, who primarily serve the domestic market.

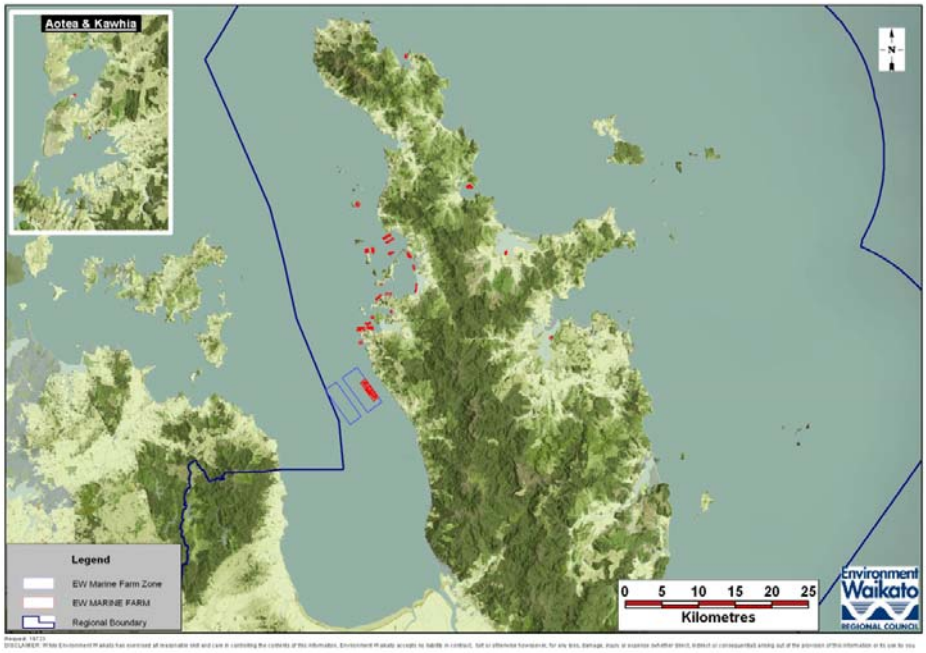
Marine farms in the region include mussel farming in the Firth of Thames, primarily in Wilson Bay, and numerous mussel and oyster farms in Coromandel and Manaia Harbours, Port Charles, Kennedy Bay, Whangapoua Harbour and Whitianga Harbour on the Coromandel Peninsula. The regional boundary also includes several proposed spat catching sites in the western Firth off Waimangu Point near Kaiaua.

The map below illustrates the locations of the farms in the region.

[21] New Zealand Aquaculture Council (2006).

[22] Source: Aquaculture New Zealand Levy data

Location of Coromandel marine farms[23]



The Sugarloaf wharf at Te Kouma on the southern side of Coromandel harbour is the primary wharf servicing the mussel industry, servicing barges for loading and unloading of product. These barges are also moored nearby at Puhi Rare Point. The Sugarloaf wharf is also used by recreational boaties and to land product from farms near Great Barrier Island.

The Coromandel wharf, which is tidal, has traditionally been the primary refuelling station. Following approval of resource consent, refuelling will now be available at Sugarloaf on weekdays.

At present there are approximately 20 barges using the Sugarloaf facility. These range in size from the older mussel barges which are of a smaller-size right up to the 30 metre special harvester vessels. There are a similar number of small 'runabout' vessels with outboards, used by farmers for farm maintenance.

[23] Note, the regional boundary has recently changed from that shown on the map to include proposed spat catching areas in the lower Firth off Waimangu Point near Kaiaua.

Oyster farmers tend to use small vessels in a variety of locations around the Peninsula, and often drive out to their farms on the mudflats. Hence while they might use the Sugarloaf wharf occasionally, it is not a regular part of their operations.

Sugarloaf wharf near Te Kouma

Improvement and expansion of regional wharf facilities is currently being considered by planners and the Hauraki-Coromandel Development Group.

This, and other development activities designed to support aquaculture, show that an appetite for growth in the aquaculture industry in Coromandel exists. Aquaculture is identified in the Hauraki-Coromandel Development Group's economic development strategy as a high priority for action, along with other industries such as tourism, transport and storage, minerals/mining, and manufacturing. [24]

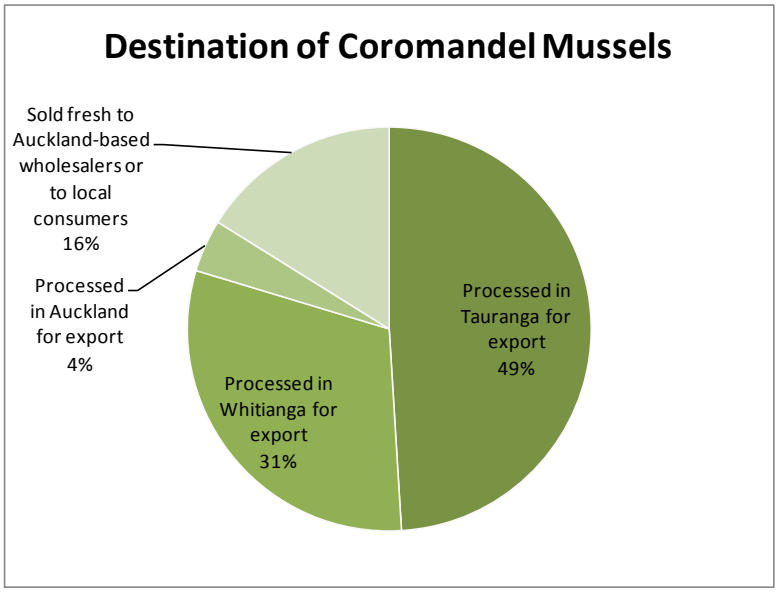
The Thames-Coromandel District Council's Blueprint project also identifies aquaculture as an important growth area for the Peninsula, noting that "significant growth is expected in the aquaculture industry".

2.6.1 Harvest and processing of Greenshell mussels

Mussel farms in the Coromandel region are estimated to have produced 31,000 tonnes of mussels in the 2010/11 financial year. In that period around 860 hectares of marine space in the Coromandel region was actively being used for mussel

[24] Coromandel Peninsula Blueprint – Volume 1 (Page 15).

farming.[25] Of these, the vast majority are processed for export: 30 percent in Whitianga, 49 percent in Tauranga and 4 percent in Auckland. The remaining 16 percent are sold fresh via wholesalers or sold direct to consumers. Frozen halfshell is the predominant form of processed product.



2.6.2 Mussel farming process[26]

The mussel farming process begins with the collection of the 'raw material'; mussel spat. Spat are very young shellfish and mussel spat develop from a floating larval stage. Spat is collected on seaweed, frames or ropes to be delivered to mussel farms. The majority of the spat used in the Waikato Region is collected from seaweed cast ashore close to Kaitaia in Northland, although a small proportion of spat is collected locally. At least one business in the Coromandel collects spat using spat catching rope frames released from existing mussel farms.

Once delivered to the farms, the spat is placed in cotton stockings and attached to longlines, a process known as seeding. Longlines consist of long ropes attached to

[25] Total consented space for mussels in the Coromandel region is 930 hectares, excluding 416 hectares issued consents in April 2011 in Area B of the Wilson Bay zone or the remaining 104 hectares in Area B that has been allocated to the Maori Trustee. An additional 7.5 hectares is consented in Aotea Harbour (West Coast Waikato region). Source: Waikato Regional Council.

[26] This section has been adapted, with minor modifications, from Environment Waikato (2007).

anchors and floats (buoys). The stockings are used to ensure that the spat attaches to the rope and does not drift away in the water. These 'seed mussels' are placed in the stocking so that they fix onto the rope at the rate of approximately 1,000 to 5,000 per metre. Once the spat has attached itself to the rope the stockings are no longer required. Over time these stockings biodegrade leaving the mussels attached to the longlines.

Mussels are filter feeders and feed on a wide range of food organisms including single cell algae, planktonic animals and detritus. These small particles are carried through the lines of suspended mussels by the constant tidal currents and provide a non-stop food source which occurs naturally in the sea water.

After a period of some 3-6 months the nursery lines are lifted and the young, but now larger (approximately 10-30 mm) mussels are stripped from the ropes. The process is then repeated with the mussels being seeded at a rate of approximately 150 to 200 per metre onto a thicker and much longer rope, using larger diameter cotton stocking to once again secure them until they attach to the rope of their own accord. If the longlines are not 'thinned out' in this manner there will be greater crop losses because mussels will fall off the ropes as they are squeezed for space as they grow. This rope is then fixed in loops or bights to the fixed surface longline where it will remain until harvest time. As before, the cotton stocking biodegrades after the mussels have firmly attached to the growing line.

The mussels are left to grow until they reach of a harvestable size, typically 80 to 110 mm. This entire process takes around 12 to 18 months. The exact timing of harvesting depends upon a couple of factors, including the time of spawning. Mussels are harvested prior to spawning to ensure they are as large as possible. Spawning causes them to lose a large proportion of their size and weight.

Weather conditions are another relevant consideration. Heavy rain can delay harvesting because of concern from the run-off from livestock farms in the region can affect the quality of the sea water. Testing is undertaken by the Coromandel Marine Farmers Association to ensure that the water quality is of sufficient standard before harvesting can be carried out.

Vessels are required for various purposes; the initial set-up of the longlines including seeding, maintenance and harvesting. Specialised barges may be used for the initial set-up and maintenance of the longlines. The process of seeding, ie attaching the spat to the lines using cotton stockings, is either undertaken by farmers themselves or contracted out. In some cases, farmers may purchase previously seeded longlines that have 'junior' mussels already attached. Smaller, less specialised vessels are often used for more routine maintenance of lines. There are approximately twenty barges servicing mussel farms in the Coromandel region and a similar number of 'runabout' dinghies.

Harvesting typically requires specialised barges that have mechanical apparatus for raising the lines and removing and bagging the mussels. The bags of harvested mussels are deposited at the wharf onto freight trucks and taken for processing. These barges tend to be large barges (16 – 22 metres) costing around $1.5 - $2 million. More specialised barges of 30 metres cost up to $3 million. The barges, along with the specialised hydraulic machinery they contain, can be expensive to maintain. While some of the larger farms own and operate their own harvesting barges, many farms will contract out the harvesting function and a small number of operators provide harvesting services.

A mussel farm also requires a shorebase where various land-based activities can be carried out. Despite the marine nature of the industry, the work carried out on land constitutes a significant proportion of farmers' efforts. Specifically, at various times anchors, ropes and floats need to be stored, cleaned, repaired and maintained. Shorebases are also needed to store vehicles and fuel, prepare cotton stockings and as a location to carry out other miscellaneous activities. Shorebases may be owned by the farmer or leased from another operator.

Mussel processing is a specialised activity undertaken in either Whitianga, Tauranga or Auckland. Processing involves cleaning off any material attached to the outside of the mussel shells. Depending upon the final product being produced, the mussels may or may not be removed from their shells, frozen and/or heat shocked and then packaged. Once packaged, the mussels are distributed to either wholesale or retail markets, including export markets.

The payments received by farmers depend not only on the size of their harvests, but also on the nature of their business relationships with the other players in the industry. For instance, farmers that have a share-cropping relationship may pay a license fee to the farm owner, contribute towards some of the operating costs and then receive a share of the final price for the processed mussels. In this case, there is no well-defined 'wholesale' price for harvested mussels at the wharf, but total revenues, and some costs, are shared between the farmer and the license holder-processor. For the purposes of this study, based on interview data, farmers are assumed to have received $650 per GWT of mussels harvested. The prices received can vary from $620 - $900 per GWT depending on individual arrangements.

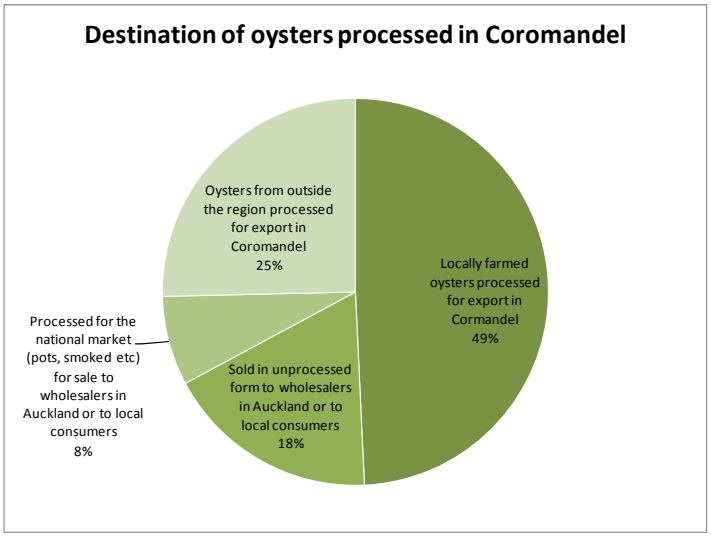
2.6.3 Harvest and processing of Pacific Oysters

Oyster farms in the Coromandel region produced 500,000 dozen oysters in the 2010/11 financial year, equivalent to 400 tonnes. In that period 70.06 hectares of marine space in the Coromandel region was actively being used for oyster farming.[27]

On oyster farms, oysters are typically attached to fixed frames that are below sea level at high tide but exposed at low tide. As with mussels, oysters are filter feeders that consume food that occurs naturally in the seawater. Once the oysters have grown to an appropriate size they are harvested.

Processing involves breaking apart clumps of oysters that move along a conveyor belt towards a high-pressure washing zone. Cleaned oysters are graded by size and then prepared for sale. Some are sold alive in unopened shells, although most are presented in half-shell form, where the flat upper shell is removed and the meat remains in the concave lower shell. Once packaged, the oysters are distributed to wholesale or retail markets.

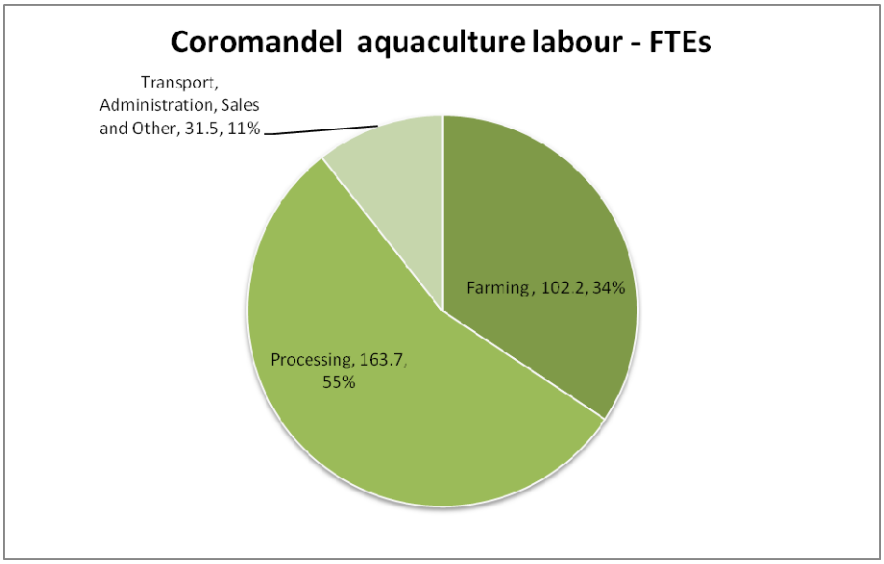
A processing facility in Coromandel township processes two thirds of Coromandel's oyster production alongside a further 170,000 dozen from farms outside the region. The remainder of the oysters are either processed for local consumers (i.e smoked or in pots) or sold fresh to wholesalers.



[27] There is 230 hectares of sub-tidal space which is consented for oyster farming but the bulk of this also consented for mussel farming. Source: Waikato Regional Council.

3 Industry employment

According to survey data, which is supported by Statistics New Zealand data, there are 297.4 Full Time Equivalent staff (FTEs) actively employed in aquaculture farming, processing, transport and administration. This estimate includes owner-operators and contractors. Direct Gross Household Income (which includes wages, savings and taxation) of $10.6 million, of which 52 percent is derived from farming and the remaining 48 percent is derived from processing.



According to Statistics New Zealand, the number of FTEs employed in aquaculture in the region has fallen in recent years. There has been a drop from 383 FTEs in 2005 to the current 297.4, a fall of 22 percent. In the same period, aquaculture production from Coromandel grew by an estimated 77 percent (from 17,600 tonnes of mussels in 2005[28] to 31200 tonnes in 2010). It is unclear what is behind the fall in staff levels, but the same trend is mirrored in national statistics. One explanation is the closure of the Coromandel mussel factory which shifted to Tauranga in around 2005. A further possible explanation is a substantial improvement in productivity, both on farm and in processing operations. Another explanation is the greater level of integration between farming and processing operations in the region.

[28] Environment Waikato (2007)

4 Results

The results shown below are an estimate of the impacts from aquaculture farming and processing from the 2010-2011 financial year. Four impacts are reported here – output, gross domestic product (GDP), gross household income and employment (FTEs). Results are given for aquaculture farming impacts, aquaculture processing impacts and the total of both. The impacts are further broken down into direct, indirect and induced impacts.

The results include an adjustment which has been made to ensure that there is no double-counting of the linkages between farming and processing. Specifically, the processing multipliers treat purchases of shellfish as an import – the purpose being to avoid feedback effects, and hence double-counting, of farming. For this reason the indirect value of output for processing is proportionately lower for processing than for farming.

A breakdown of expenditure on each of mussel farming, mussel processing, oyster farming and oyster processing has been provided in Appendix A. This has been converted into percentages for reasons of commercial sensitivity.

4.1 Multipliers

An increase in final demand for any sector has repercussions throughout the whole economy, not just for that one sector. The effect of a change in demand in one sector is 'multiplied', through the effects of changes brought about in other sectors. Thus, multipliers are a ratio of the overall economic change to the (initial) direct change in the economy, given that economic activity in one sector has knock-on effects in other sectors.

The multipliers that were applied in this study are shown in the table below. They were prepared by Butcher Partners Limited, using primary data collected during the interviews conducted for this study. The reliability of the multipliers was confirmed by comparing the results to earlier work by COVEC and Market Economics (although differences exist due to changes in prices, changes in technology, sources of inputs and so on).

As described in section 1.2, Type II differs from type I as the former includes induced effects, along with direct and indirect effects. For example, the table below shows that if output from mussel farming were increased by $1,000, the overall output from the regional economy would increase by $1,370 (the Type II multiplier is 1.37). This takes into account induced effects. This includes the original $1,000, plus an additional $370 through repercussionary effects in other sectors associated with

aquaculture and also through increased household expenditure, brought about by wages and salaries paid to employees of the aquaculture sector.

As with the economic impacts, a breakdown of the multipliers is also given for both farming and processing, alongside the total sector impact.

Aquaculture multiplier set – Waikato Region (Source: Butcher Partners)

Waikato region	*Mussel Farming*	*Oyster Farming*	*Mussel Processing*	*Oyster Processing*	*Integrated Finfish Farming and Processing*
Output Multipliers					
Type I Output Multiplier	1.15	1.53	1.38	1.21	1.16
Type II Output Multiplier	1.37	1.93	1.60	1.47	1.36
Impact Ratios					
Total Value Added: Gross Output ($\$_{2010}$)	0.73	0.99	0.57	0.65	0.62
Total Gross Household Income: Gross Output ($\$_{2010}$)	0.34	0.62	0.33	0.39	0.31
Total Employment: Gross Output (FTEs/$\$_{2010}$mil)	6.61	10.03	10.52	3.37	6.30

Aquaculture multiplier set – New Zealand (Source: Butcher Partners)

New Zealand	*Mussel Farming*	*Oyster Farming*	*Mussel Processing*	*Oyster Processing*	*Integrated Finfish Farming and Processing*
Output Multipliers					
Type I Output Multiplier	1.70	1.82	1.49	1.28	1.37
Type II Output Multiplier	2.21	2.57	1.88	1.71	1.78
Impact Ratios					
Total Value Added: Gross Output ($\$_{2010}$)	1.08	1.27	0.73	0.76	0.81
Total Gross Household Income: Gross Output ($\$_{2010}$)	0.54	0.79	0.41	0.45	0.43
Total employment: Gross Output (FTEs/$\$_{2010}$mil)	14.02	14.19	12.09	4.25	8.41

4.2 Economic impacts

Aquaculture and its ancillary industries contributed $31.4 million of value added or gross regional product (GRP) to the Waikato region, or 0.2 percent of Waikato's

total GRP[29]. In terms of employment, there are 432.3 full time equivalents (FTEs) resulting from aquaculture in the Coromandel region (297.4 of these are employed directly by the industry).

By comparison, dairy farming in the Waikato region contributed 8.1 percent of the region's GRP and dairy factories contributed a further 2.7 percent[30]. In sum, around 10.8 percent of regional GRP.

Economic impact of the Coromandel aquaculture industry – Waikato Region 2010/11 financial year (NZD_{2010}$)

Waikato region	*Shellfish Farming*	*Shellfish Processing*	*Total Impact*
Output			
Direct	$21.8	$26.2	$48.0
Indirect	$3.9	$9.2	$13.1
Induced	$5.1	$5.8	$10.9
	$30.8	***$41.1***	***$71.9***
Value Added (GDP)			
Direct	$11.8	$7.6	$19.4
Indirect	$1.8	$4.5	$6.3
Induced	$2.7	$3.1	$5.7
	$16.2	***$15.2***	***$31.4***
Gross Household Income			
Direct	$5.4	$5.2	$10.5
Indirect	$1.3	$2.3	$3.6
Induced	$1.2	$1.4	$2.5
	$7.8	***$8.8***	***$16.6***
Employment (FTEs)			
Direct	121.2	176.3	297.4
Indirect	10.5	62.0	72.5
Induced	26.3	36.0	62.4
	158.0	***274.2***	***432.3***

[29] Total regional GRP for Waikato is estimated to have been $15.4 billion in the year to March 2011 (Sapere analysis, using data from www.rbnz.govt.nz)

[30] Source: Waikato Regional Council

When measured for its value to the national economy, the Coromandel aquaculture industry contributes $77.4 million in GDP to the national economy – and generates a total of 1,193full-time equivalent jobs. The results show that Coromandel's aquaculture production generates significant impacts from aquaculture-related activities in adjoining regions.

Economic impact of the Coromandel aquaculture industry – National 2010/11 financial year (NZD_{2011}$)

National (total)	*Shellfish Farming*	*Shellfish Processing*	*Total Impact*
Output			
Direct	$21.8	$73.8	$95.6
Indirect	$15.4	$34.8	$50.1
Induced	$11.6	$29.3	$40.9
	$48.8	***$137.9***	***$186.7***
Value Added (GDP)			
Direct	$11.8	$22.4	$34.1
Indirect	$6.4	$16.2	$22.6
Induced	$5.9	$14.9	$20.7
	$24.1	***$53.4***	***$77.4***
Gross Household Income			
Direct	$5.4	$13.6	$18.9
Indirect	$3.8	$9.3	$13.1
Induced	$2.9	$7.4	$10.3
	$12.1	***$30.3***	***$42.4***
Employment (FTEs)			
Direct	121.2	430.0	551.2
Indirect	117.7	259.7	377.4
Induced	75.4	189.5	264.8
	314.2	***879.2***	***1193.4***

4.2.1 Gross Output

Gross output is the total value of sales before subtracting the value of intermediate goods used in the production of the output. Gross output is used as a basis for the calculations of value added, gross household income and employment – it is not a particularly useful metric on its own as it does not account for the inputs used in production.

The gross output associated with the aquaculture industry in the Waikato for the 2010/2011 year was $71.9 million. The contribution of farming and processing to this total was shared: farming contributing 42 percent with $31 million worth of output, and processing contributing 58 percent with $41 million of output. The gross output

figures were further split into direct (aquaculture industry – farming and processing), indirect (associated industries that supply to the aquaculture industry and also use aquaculture produce) and induced output (associated with the extra money spent in the economy from wages paid within the aquaculture sector). The direct total impact of aquaculture constituted $48 million of gross output (67 percent), indirect was 18 percent, with induced being the remaining 15 percent.

4.2.2 Value Added

Value added or gross domestic product (GDP) is the value of sales minus the value of intermediate goods used in the production of that output. The aquaculture industry and supporting industries are estimated to account for $31.4 million of Waikato's GDP. The contribution to GDP is comprised of aquaculture farming impacts ($16.2 milllion or approximately 43 percent of total) and aquaculture processing impacts ($15.2 million or 57 percent of total).

4.2.3 Gross Household Income

Gross Household Income is the amount of money flowing to households in the region. Many economists view this measure as more appropriate than GDP as a measure of welfare[31]. The measure of Gross Household Income includes savings and taxation.

Households in the Waikato region are estimated to have received $10.5 million directly in wages or drawings (including savings and taxation) as a result of aquaculture activities. With the addition of indirect and induced effects, household income increases to a total of $16.6 million. This effect will be mostly concentrated in the Coromandel area.

4.2.4 Employment

Within the region, the industry directly employed 297.4 full time equivalents (FTEs): 121.2 in marine farming and 176.3 in aquaculture processing. Nationally, there are 551.2 FTEs employed directly, as a result of production from the Coromandel .

Indirect and induced impacts on employment account for a large number of additional jobs. The total employment associated with the aquaculture industry in Coromandel, including direct, indirect and induced employment, is estimated to be 432.3 FTEs within the region and 1194 nationally.

[31] See, for example, Coleman, W. (2008)

5 Future growth scenario

One of the goals of this study is to gauge the extent of the likely economic change that will be brought about by expected growth in farming in the region over the next 15 years. This report develops a scenario in which production from the region's farms has increased to reflect the development of new tracts of farm space, and where finfish farming has been introduced to the region.

This scenario was developed in consultation with the industry, and involves an increase in the space used for mussel farming by 640.5 hectares and moderate increases in industry productivity. In summary, the scenario involves:

- An increase in mussel production from the estimated 31,000 green weight tonnes to 60,000 green weight tonnes;
- An increase in oyster production from 500,000 dozen to around 1,000,000 dozen;
- The addition of three finfish farm sites producing a total of 6,000 tonnes of kingfish.

5.1 Growth in mussel production

Coromandel production of Greenshell mussels is projected to increase from the current estimated production of 31,000 tonnes to over 60,000 tonnes by 2025, given the right market and infrastructure conditions. This growth in production is likely to come primarily from development of a further 640.5 hectares of mussel farming space in the region. This will likely occur in Wilson Bay B (520 ha), further development in Wilson Bay A. (additional 70.5 ha becoming operational), and a series of small extensions and realignments (net additional 50 ha becoming operational). There are also applications for conversion of spat space in the Western Firth, which may take production beyond 60,000 tonnes.

The scenario for mussels assumes that the location of mussel processing will continue in Whitianga, Tauranga and Auckland, in roughly the same proportion as currently.

The current mussel processing operations in Whitianga are relatively labour intensive. In contrast, the processing facility in Tauranga requires fewer labour inputs per tonne processed as a result of a recent $23 million factory upgrade. Over time, an increased level of automation can be expected (and this would be reflected in the results by higher profits but lower overall expenditure on labour). This may prove a boon in some areas of the Coromandel where labour workforce issues have proved a limiting factor to processing greater volumes.

While it is likely that economies of scale will be experienced with greater volumes being produced, no economies have been incorporated into the expenditure figures in the future scenario. This is due to the difficulty in estimating these with any accuracy. Nor have changes to wider industry dynamics, such as the location of processing and the mode of transport of goods.

5.2 Growth in oyster production

The scenario for oyster production assumes that the hectarage for oysters will remain largely unchanged but that farmers in the region will likely convert production from racks to basket technology, and may use single seed hatchery spat instead of wild-caught spat. This can be expected to double the output of the region's oyster farms by 2025, as the same hectarage can be used more intensively and for a longer duration. The scenario also assumes, perhaps optimistically, that disease incursions such as the herpes outbreak experienced earlier this year will not be regular features.

5.3 Impacts of mussel and oyster growth

The growth in production of mussels and oysters from the Coromandel region is expected to see the mussel and oyster industry contributing a total of $60.7 million in GDP to the regional economy by 2025, and bringing in 835 full-time jobs (in other words, creating 403 new full-time equivalent jobs across the region).

At the national economy level, the Coromandel shellfish (mussel and oyster) industry will generate in $149.3 million in GDP by 2025, and generating 2,304full-time equivalent jobs.

5.4 Finfish developments

The Government has passed legislation to allow finfish farming in the Hauraki Gulf and in the Coromandel Marine Farming Zone. The proposed area for development amounts to about 300 ha of space located in the southeastern Hauraki Gulf seaward of the Firth of Thames and West of Coromandel township, and 90 ha of vacant space in the Wilson Bay zone. These areas could potentially allow 12,000 tonnes per annum of fish production.

In the lead up to the legislative change, the Ministry of Fisheries and other interested parties contracted research into the production and ecological issues associated with finfish farming. According to NIWA research, the designated location "appears to provide for the environmental requirements (temperature, oxygen, chemistry, sanitation, depth, wave and current conditions) of the species, and for the operational requirements of the farm system."

The research also concludes that farming activities in new zone may involve production of kingfish (*Seriola lalandi lalandi*) and/or a mixture of kingfish and hapuku (*Polyprion oxygeneios*) culture. To our knowledge, research into kingfish culture methods and ecological impacts is more advanced, however, and it is likely that this species will be the first to be trialled in the region.

The paper "Finfish Culture in Wilson's Bay: A Bio-Economic Analysis"[32] stated that a dual 5 ha site, totalling 10 ha, with optimised production could produce up to 2,000 tonnes per year. Therefore this study assumes that three sites of 10 hectares each would support production of 6,000 tonnes. It is possible that one site would be located in Wilson Bay, the others in the Coromandel Marine Farming Zone.

The farm configurations employed would be able to cope with occasional ocean swells that penetrate the Gulf and Firth. Prudent farm management would include oxygen monitoring at the farm level, control of excessive bio-fouling on nets and avoidance of excessive stocking densities. The farm(s) would likely operate under an integrated fish health and biosecurity management plan including standard operating procedures which control the operation and movement of boats, fish, feed, equipment or infectious material between farms.

It is likely that a substantial proportion of the farmed fish would be sold as processed product to offshore consumers. If industry decided it was economic to build a new finfish processing factory (or refurbish an existing factory) in the region, then processed product could be taken by existing refrigerated trucks to the Auckland fish market or the Auckland International Airport. Alternatively, the processed products could potentially be carried by ferry from Coromandel directly to the Auckland airport. It could be equally possible, however, that farmed fish may be processed outside the region, most likely in Auckland.

As it is unclear what may occur in the future, the scenario adopted by this study is that kingfish will be the species farmed. While there is potential to farm a greater volume of fish given approved discharge limits, this study adopts a conservative estimate of production of 6,000 tonnes of Kingfish (5175 tonnes head off, gilled and gutted (HoGG)) from the region by 2025[33]. This study further assumes that all of the fish is processed at a facility in the Coromandel region, for example in Whitianga or

[32] NIWA (2008)

[33] The results are reasonably scalable, that is, the effects of farming 12,000 tonnes can be estimated by doubling the results for 6,000 tonnes, although at levels of production beyond 6,000 tonnes no economies of scale in farming or processing will be taken into account.

Coromandel township, and that the bulk of the processed product would be exported.

Production at this level would require approximately 2.1 million fingerlings[34]. New Zealand does not currently have the capacity to produce fingerlings in such quantities, but this capability can be expected to develop in the future. The assumption made in this study is that fingerlings come from out of region at Bream Bay. A further assumption is that fish feed would be sourced from suppliers overseas, with a feed conversion ratio of 1.7.

It is likely that the farms would be fully vertically integrated[35] with processing facilities. For this reason the costs, revenues and multipliers have been calculated for an integrated farm/processing facility. With export revenues of $9.38 per kilo harvested[36], the 6,000 tonnes of product harvested from the region's farms translates to revenue for the producers (direct output) of $56.3 million per annum.

While there are clear differences in farming methods, one of the best available proxies for the cost structure for finfish farming is the current salmon farming industry. Both industries have a large proportion of imported inputs, namely fish food. Because such a large proportion of any additional output (and thus export revenue) is effectively 'financed' through imports, the GDP impact (value added) of production is dampened.

Three farm sites producing a total of 6,000 tonnes is expected to directly employ 231.8 full time equivalents in farming, processing, and associated transport and administration[37]. A further 122.6 FTEs would be generated as a result of indirect and induced economic activity.

---

[34] Based on ratios applied from: Giorgetti, A. (2010)

[35] 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.

[36] The estimate of export revenue is derived from NZIER (2010), pg 3, assumption of $75 million export revenue for 8,000 tonnes (GWT).

[37] This estimate is based on ratios between output and employment. The export price assumption of $9.38 per kilogram applied in this study is in our view, conservative. It is lower than that applied in Giorgetti (2010). Higher prices per tonne, and higher employment per tonne, would arise from greater levels of revenue. Higher employment figures would be consistent with data from major fish processor NZ King Salmon, which produces and processes 8400 tonnes (gilled and gutted) of salmon employs approximately 460 people in its farming, processing and sales and marketing operations (Data available from www.kingsalmon.co.nz). A direct pro-rating of NZ King Salmon's employment based on production would suggest 328.5 employees.

The multipliers used for the analysis of Kingfish farming were generated using confidential data generated for an economic study of kingfish farming in Northland, which in turn was based on the structural relationships that exist for salmon farming and processing. This was the best data available for the purpose. This data was not seen by the author. However, a summary can be found in Giorgetti (2010).

This study estimates a contribution of an additional $34.9 million in GDP to the regional economy from finfish farming. Assuming that the finfish processing can be done on the Peninsula (either at the existing fish factory in Whitianga, or at new plants built at Coromandel or Thames), this will create an additional 354.4 full-time equivalent jobs. At the national level, finfish farming in the Coromandel is predicted to bring in an additional $45.6 million in GDP to the New Zealand economy, and create 473.6 new full-time equivalent jobs.

5.5 Total output in future scenario

The table below illustrates how output from Coromandel's aquaculture industry will change with the increased production of mussels and oysters and the addition of finfish farming. These output figures were used as the basis for the calculation of value added, gross household income and employment.

Estimated Regional Revenue (Output) in Future Scenario ($2010 real)

Direct Waikato Output NZD 2010 Millions	*Shellfish Farming*	*Shellfish Processing*	*Integrated Finfish Farming and Processing*	*Total Output*
Existing output	$21.8	$26.2	-	$48.0
Kingfish farming and processing			$56.3	$56.3
Increased oyster production	$1.7	$3.8		$5.5
Increased mussel production	$18.6	$20.6		$39.2
TOTAL	**$42.1**	**$50.6**	**$56.3**	**$148.9**

Source: Sapere analysis

A Kingfish farming operation generating 6000 tonnes greenweight per annum, which is then processed in the region, can be expected to generate $56.3 million in direct revenue for the producers (direct output). Increasing oyster production to 1 million dozen can be expected to add $5.5 million in direct output, while increasing mussel production to 60,000 GWT can be expected to add $39.2 million in direct output. In total, an extra $148.9 in direct output will be generated in Waikato.

Nationally, as shown in the table below, the direct output generated will be $240.6 million. This assumes that the location of processing of mussels and oysters remains in the same proportions as currently.

Estimated National Revenue (Output) in Future Scenario ($2010 real)

Direct National Output NZD 2010 Millions	*Shellfish Farming*	*Shellfish Processing*	*Integrated Finfish Farming and Processing*	*Total Output*
Existing output	$21.8	$73.8	-	$95.6
Kingfish farming and processing			$56.3	
Increased oyster production	$1.7	$4.8		$6.5
Increased mussel production	$18.6	$63.7		$82.3
TOTAL	**$42.1**	**$142.3**	**$56.3**	**$240.6**

Source: Sapere analysis

5.6 Total economic impacts in future scenario

The table below summarises the economic impacts in the region, should the levels of production and direct output set out in the preceding paragraphs eventuate.

Waikato region	*Shellfish Farming*	*Shellfish Processing*	*Integrated Finfish Farming and Processing*	*Total Impact*
Output				
Direct	$42.1	$50.6	$56.3	$148.9
Indirect	$7.5	$17.8	$9.0	$34.3
Induced	$9.8	$11.2	$11.8	$32.8
	$59.4	***$79.5***	***$77.1***	***$216.0***
Value Added (GDP)				
Direct	$22.7	$14.7	$24.8	$62.2
Indirect	$3.4	$8.8	$3.9	$16.2
Induced	$5.1	$5.9	$6.2	$17.3
	$31.3	***$29.4***	***$34.9***	***$95.6***
Gross Household Income				
Direct	***$10.3***	***$10.0***	***$12.9***	$33.2
Indirect	$2.4	$4.5	$2.4	$9.3
Induced	$2.2	$2.6	$2.4	$7.3
	$15.0	***$17.1***	***$17.7***	***$49.8***
Employment (FTEs)				
Direct	233.7	341.0	231.8	806.4
Indirect	20.3	119.8	60.2	200.3
Induced	50.8	69.7	62.4	182.9
	304.8	***530.5***	***354.4***	***1189.6***

Nationally, the impacts will be as follows:

National	Shellfish Farming	Shellfish Processing	Integrated Finfish Farming and Processing	Total Impact
Output				
Direct	$42.1	$142.3	$56.3	$240.6
Indirect	$29.6	$67.1	$20.8	$117.5
Induced	$22.4	$56.5	$23.1	$102.0
	$94.1	***$265.9***	***$100.1***	***$460.2***
Value Added (GDP)				
Direct	$22.7	$43.1	$24.8	$90.6
Indirect	$12.4	$31.1	$9.0	$52.5
Induced	$11.3	$28.7	$11.8	$51.8
	$46.4	***$102.9***	***$45.6***	***$194.9***
Gross Household Income				
Direct	***$10.3***	***$26.1***	***$12.9***	$49.4
Indirect	$7.4	$17.9	$5.6	$30.9
Induced	$5.6	$14.3	$5.6	$25.5
	$23.3	***$58.3***	***$24.1***	***$105.8***
Employment (FTEs)				
Direct	233.7	829.1	231.8	1294.6
Indirect	227.0	500.8	120.4	848.2
Induced	145.4	365.3	121.5	632.2
	606.1	***1695.2***	***473.6***	***2774.9***

In summary, the analysis estimates that:

- The Coromandel industry's combined contribution from mussels, oysters and finfish to the regional economy by 2025 will be $95.6 million in GDP, with the generation of 1,190 full-time equivalent jobs.
- At the national level, the Coromandel industry will contribute $194.9 in GDP, and generate a total of 2,775 full-time equivalent jobs.

5.7 Where the impacts from growth will be felt

Economic impacts from the increased levels of aquaculture production in the region can be expected to occur in the following areas:

- Supplying industries – industries that supply the farms with intermediate inputs, like suppliers of farm equipment or boats, will benefit. The national fishing industry may end up supplying fish feed to the farms. In addition, facilitating industries like transport and business services will benefit.
- Household expenditure industries – industries that households spend money on will benefit as increased incomes from marine farming are spent in the region. Such industries include housing and real estate and consumption goods like retail trade.
- Investment related industries – There will be impacts, temporary in nature, on the construction sector as farms and accompanying infrastructure like roads, wharves and shore facilities are built.

There will also be negative impacts on some industries if investment expenditure is diverted away from certain types of production and put into aquaculture. Other industries may suffer as resources become more scarce, and thus more expensive. Labour is one example of this. So for example you may see labour being diverted from horticulture or fishing in the region and into aquaculture.

6 Acknowledgements

The contribution of the aquaculture businesses in the Coromandel region, who took time to participate in interviews and follow-up phone calls in this study is greatly appreciated. A particular thanks to Peter Vitasovich of NIMPL for his responses to follow-up questions. Thank you also to Ben Dunbar-Smith of the Hauraki-Coromandel Development Group for undertaking the interviews for this study and for the use of information on the industry. Thanks also to Geoff Butcher of Butcher Partners Limited, Garry McDonald of Market Economics Limited and Graeme Silver of Waikato Regional Council for their comments and advice.

7 References

Albino, V., Izzo, C. and Kühtz, S. (2002) Input-output models for the analysis of a local/global supply chain. International Journal of Production Economics. Volume 78, Issue 2, 21 July 2002, Pages 119-131

Aquaculture New Zealand (2011). Levy data 2010.

Aquaculture New Zealand (2009). New Zealand Aquaculture Farm Facts. 2nd edition. June 2009.

Coleman, W. (2008). Gauging Economic Performance under changing terms of trade: real gross domestic income or real gross domestic product? Economic Papers, Vol 27 no.4 December 2008.

Dunbar-Smith, B. (November 2010) . Issues and options for wharfing infrastructure to support the Coromandel aquaculture industry. Report prepared for the Hauraki-Coromandel Development Group.

Environment Waikato (2007). Economic Impact of Aquaculture in the Waikato Region. Report prepared by Covec for Environment Waikato. Available at http://www.ew.govt.nz/Publications/Technical-Reports/Economic-Impact-of-Aquaculture-in-the-Waikato-Region/

Ernst & Young. (2009). New Zealand Aquaculture Industry Growth Scenarios. Report to Aquaculture New Zealand.

F.A.O. (2009). The State of World Fisheries and Aquaculture, 2008. Rome: United Nations Food and Agriculture Organisation.

Giorgetti, A. (2010), The Northland Regional Economic Impacts of Aquaculture – Report to Northland Regional Council. Enveco, February 2010.

Kronenberg, T. (2009) Construction of regional input-output tables using non-survey methods. International Regional Science Review. Vol. 32, No. 1, 40-64 (2009).

Market Economics Ltd. (2008) Economic impacts of the seafood sector in New Zealand. Report prepared for the Ministry of Fisheries, October 2008.

Murray, C.; and McDonald, G.; (2010). Aquaculture: Economic impact in the Auckland region. Jointly prepared by the Auckland Regional Council and Market Economics Ltd for Auckland Regional Council. Auckland Regional Council Document. Technical Report no. 009, 2010. Available at www.knowledgeauckland.org.nz

NZIER (2010). Value of kingfish and hapuku farming – Preliminary analysis. Report to Ministry of Fisheries.

NZIER (2010). Net Economic Benefit of Aquaculture Growth in New Zealand – Scenarios to 2025. Report to Aquaculture New Zealand.

New Zealand Aquaculture Council (2006). The New Zealand Aquaculture Strategy. Report written by Mike Burrell and Lisa Meehan of LECG Ltd for the New Zealand Aquaculture Council, the New Zealand Seafood Industry Council and the Ministry of Economic Development.

PricewaterhouseCoopers (2006) Economic Assessment of Aquaculture. Generalised methodology. Report written in collaboration with New Zealand Trade and Enterprise, the Auckland Regional Council and Environment Waikato. Available at: http://www.aquaculture.govt.nz/files/pdfs/NZTE_Aquaculture_Rept.pdf

Reserve Bank of New Zealand Gross Domestic Product series, available from www.rbnz.govt.nz

Statistics New Zealand (2007) Regional input-output study. Retrieved from http://www.stats.govt.nz/

Zeldis, J et al (December 2010), Waikato Marine Finfish Farming: Production and Ecological Guidance, NIWA client report CHC2010-147

Appendix A – Summary of assumptions

Assumption	*Assumption used*	*Data source*
Estimated Coromandel mussel production (GWT), May 2010 – April 2011	31,000	Industry interviews; checked against Aquaculture NZ data
Estimated Coromandel oyster production (doz.), May 2010 – April 2011	500,000	Industry interviews; checked against Aquaculture NZ data
Mussel export price (per kg, frozen HS)	$5.23 (see section 2.3)	Industry interviews; Aquaculture NZ export database, monthly average for year from May 2010 – April 2011
Oyster export price (per kg, frozen HS)	$8.29 (see section 2.4)	Industry interviews; Aquaculture NZ export database, monthly average for year from May 2010 – April 2011
Farm and processing cost data, processing volumes, farm gate prices for shellfish	These inputs are commercially sensitive (but see Appendix B for an indication of expenditure distributions)	Industry interviews; comparisons with Covec 2007 and Market Economics 2010; author's own data
Farm and processing labour	Direct regional employment: 121.2 Aquaculture farming; 176.3 Aquaculture processing Direct national employment: 121.2 Aquaculture farming; 430 Aquaculture processing See section 3	Industry interviews; Sapere analysis; checked against Statistics New Zealand enterprise data

Appendix B - Expenditure breakdown[38]

Mussel farm expenditure (excl. Taxation)	
Spat and seeding (excl. labour inputs)	36.1%
Farm labour	23.7%
Off-farm labour (admin and transport)	8.3%
Anchors, Warps, Backbone, Bouys, Lights etc	8.3%
Growing Rope	5.3%
Harvest cost (excl. labour inputs)	5.1%
Farm maintenance and monitoring (excl. labour inp	4.8%
Shorebase and Farm equipment (compressors, clea	2.4%
Industry levies	2.2%
Local government services	1.2%
Legal services	0.8%
Accounting services	0.8%
Communication services	0.5%
Wharfage	0.3%
General insurance	0.1%

Mussel processing expenditure (excl. Taxation)	
Purchase of mussels	26.8%
Processing labour	21.1%
Freezing, waste control etc	17.3%
Maintenance and processing costs (excl. labour; in	13.2%
International freight (assume product is exported)	11.1%
Packaging	5.6%
Land and building	2.6%
Transport to factory from wharf	0.9%
Communication services	0.7%
Local government administration services and civil	0.4%
General insurance	0.1%
Legal services	0.1%
Accounting services	0.1%

[38] These figures are generated from mock farm accounts, which are based on Sapere analysis using a number of data sources including data from surveys, data from previous economic impact studies on aquaculture and data held by the author.

Oyster farm expenditure (excl. Taxation)	
Labour costs	29.6%
Maintenance on structures or replacement sticks a	30.3%
Spat costs - spat on sticks	16.1%
Maintenance or replacement farm equipment, boat	11.2%
Fuel for boats	4.5%
Land base operating costs	1.9%
Legal services	1.6%
Accounting services	1.6%
Government monitoring and water testing	1.3%
Industry levies	0.6%
Business administrative and management services	0.5%
General insurance	0.4%
Communication services	0.4%

Oyster processing expenditure (excl. Taxation)	
Purchase of oysters	48.5%
Processing labour	18.9%
Machinery maintenance and packaging	17.3%
Sales and admin	8.9%
Land and building	1.7%
Freight (all types)	1.3%
Legal services	1.0%
Accounting services	1.0%
Business administrative and management services	0.7%
Communication services	0.4%
Rates	0.2%
General insurance	0.1%