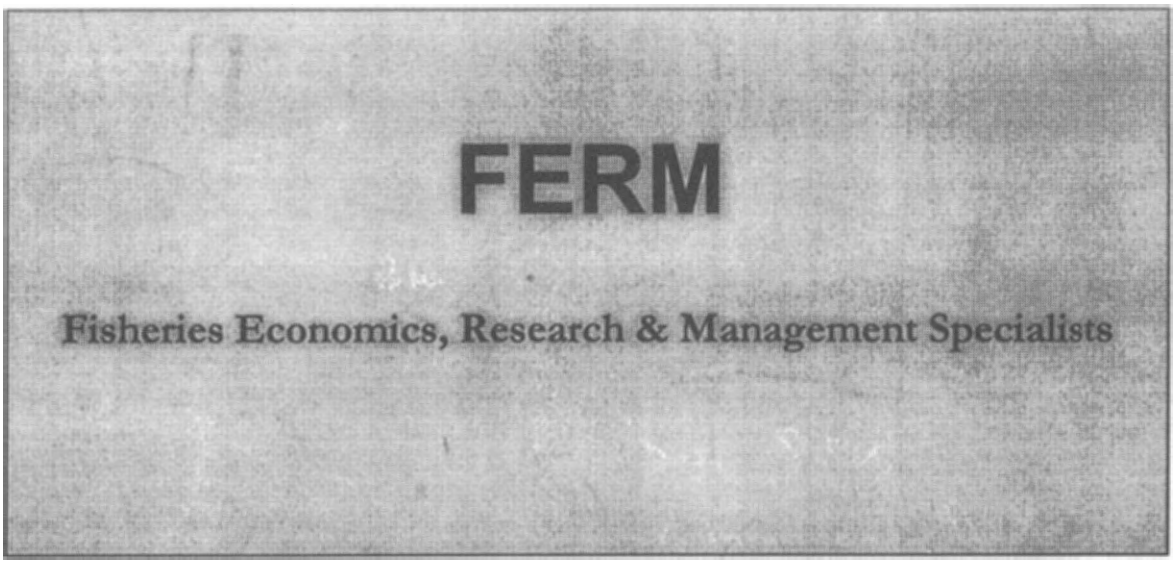

EX-POST COST/BENEFIT ANALYSIS OF FOUR FRDC-FUNDED PROJECTS

PREPARED FOR THE FRDC

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EXECUTIVE SUMMARY

In this study four completed research projects were evaluated using the techniques of cost/benefit analysis. A range of different types of projects was chosen to span all FRDC program areas. Also, projects had to be completed (preferably several years ago) and, for logistical reasons, to be undertaken by organisations based in eastern Australia.

A brief summary is given below of the results of the analysis of each project. Table 1e identifies the costs and estimated research benefits for each project.

1. Project No: 92/71 "Live Transport of Crustaceans in Air: Prolonging the Survival of Spanner Crabs"

This project was undertaken by the International Food Institute of Queensland. The purpose was to develop new in-transit storage methods for live spanner crabs destined for export markets with a view to prolonging their survival. Research revealed that changes in storage methods (during transport to export markets) made little difference to the mortality rates of the crabs, and that the underlying problem was that crabs were already highly stressed by poor handling on fishing vessels.

The project was extended to examine the effects of alternative on-board handling techniques on crab mortality rates, and to hold a workshop to disseminate the results. It was found that significant improvements in crab survival resulted from holding the crabs in cool, moist conditions on-board the fishing vessel, compared to the industry practice of holding the crabs on deck in baskets.

Although this result was widely disseminated to industry, there was little change in industry practices with respect to on-board crab handling. This was mainly because the limited entry and competitive TAC management regime in place in the fishery provided little incentive for fishers to deliver quality products. As a result, there have been no tangible benefits from the research. However, a forthcoming change to ITQ management will probably provide the necessary incentive to operators to accept the research advice and modify their crab handling practices.

2. ***Project No: 92/125.32 "Improving Packaging Technology, Survival and Market Options for Kuruma Prawns"***

This project was undertaken jointly by the Centre for Food Technology and the Bribie Island Aquaculture Research Centre in Queensland. There were two components to this research. The first was to develop new packaging to reduce in-transit mortality rates of kuruma prawns destined for the Japanese market. The second component was to examine whether kuruma prawns (normally grown in southern Queensland) could be successfully produced and exported, or sent south for climatic agistment, from northern Queensland prawn farms. Faster growth rates and the possibility of two crops per year provided incentive for investigation of the potential for the kuruma prawn industry in northern Queensland.

The study showed that year-round production from northern Queensland sites is infeasible due to the effects of high ambient pond temperatures on prawn mortality. However, production in northern Queensland during the colder months, possibly followed by climatic agistment in more southerly sites, was considered worthy of commercial trials. As nothing has yet come of this research finding, no benefits are attributed.

A new package, with enhanced temperature control features, was successfully developed for the airfreight of live kuruma prawns to the Japanese market. Its adoption by farmers was expected to deliver improved prawn prices as a result of lower in-transit prawn mortality and because of increased market confidence in the Australian product. However, farmers have not used the new packaging, nor do they apparently intend to do so. This is because the mortality rates reportedly being achieved with existing, cheaper packaging are quite satisfactory, being consistently less than 5%. Moreover, farmers believe that the residual mortalities have more to do with the mistaken selection of weak prawns for packing rather than with poor temperature control.

As there has been no adoption of the new packaging, there are no apparent benefits arising from the research.

3. *Project No: 94/128 "Assessment of the Impact of Environmental Factors and New Technology on the Northern Prawn Fishery"*

This project was carried out by CSIRO's Division of Fisheries in Cleveland. The purpose was to investigate two issues which create uncertainty about the assessment of the tiger prawn stocks in the NPF. Specifically, the effects of environmental variables on fluctuations in prawn abundance, and the effect of the introduction of GPS on the effectiveness of fishing effort were to be estimated.

The study failed to discover any environmental factors that explained inter-annual variation in catches of tiger prawns throughout the NPF, although analyses suggested the existence of relationships in some areas of the fishery. Little confidence was placed on these results and, as no use have been made of them in stock assessment, no benefits are attributed.

The research on the impact of GPS on the effectiveness of fishing effort indicated that effective fishing effort had grown by 12% after three years of use. It was recommended that an annual rate of increase of 5% continue to be used to account for additional components of effective effort growth. This result effectively "drives" the stock assessment model which indicates that fishing mortality on tiger prawn stocks is too high and that effort should be reduced substantially in the fishery. While the 5% figure was used in previous stock assessments, it was argued that industry support for continued use of this assumption was wavering until the results of this research were made available.

Increased industry confidence in the stock assessment, resulting from this research, facilitated negotiations between AFMA and industry on the development of an effort reduction programme. It was agreed that the programme would be implemented in 1999. According to AFMA and the principal stock assessment scientist, gaining industry agreement to the programme in the absence of the research results would have taken at least one more year. The benefits of the research are, therefore, estimated as the discounted difference in the profits of the fleet under (the same) effort reduction programme starting in 1999 and 2000, respectively.

The earlier effort reduction programme generates substantially more economic benefits than the alternative, starting only one year later. This is because "effort creep" increases the fishing costs of the fleet during 1999, eroding in advance the potential gains from the 2000 effort reduction programme.

4. Project No: 94/053 "An Assessment of the Impact of Offshore Recreational Fishing in New South Wales Waters on the Management of Commercial Fisheries"

This project was undertaken by the NSW Department of Fisheries. The purpose was to estimate the total harvest and fishing effort of recreational anglers fishing NSW offshore waters, and to relate these results to the allocation of fish resources between recreational and commercial users.

Data was collected mainly using a large scale boat ramp survey and supplemented with data from vessel movement logbooks kept by the Coastguard and Coastal Patrol. One of the main findings was that recreational fishers collectively harvest large quantities of many species shared with the commercial sector. It was recommended that the recreational and charter boat sectors become subject to enhanced monitoring, that the data be used in stock assessments and for inter-sectoral resource allocations, and that recreational fishers be given greater input to management decision-making on shared resources.

An indication of the value placed on the research is that a "Recreational Fishing Research Group" was established by the Fisheries Department to implement fully the recommendations of the study. One of the main outcomes of the research has been the establishment of seven regional recreational fishing advisory bodies to provide management advice to the Department. These groups, together with their commercial counterparts, were able to negotiate a set of 100 beach closures to commercial "netters", offset by the provision of priority access rights to commercial fishers in other locations. These closures have been implemented by the Department, which indicated that this resource allocation would have been much more difficult to accomplish in the absence of the new institutional framework.

It is difficult to ascribe monetary benefits to this project in terms of changes in commercial harvesting profits and angler satisfaction. Nonetheless, this should not be interpreted to imply that the research was without value. It is our opinion that the research did produce significant non-quantifiable benefits in terms of facilitating conflict resolution between the commercial and recreational sectors (through the collection of catch data and the development of a new institutional framework). Overtime, this should increase the probability of more rationale resource allocations and, in turn, result in quantifiable economic benefits.

Table 1e: Summary of research costs and estimated benefits across four selected projects

Project	Total cost	FRDC cost	Total benefits	Benefits from FRDC funding	FRDC benefit/cost ratio	Future benefits
1. Survival of spanner crabs	**$275,749**	**$100,832**	**$0**	**$0**	**nil**	**Probable**
2. Packaging for kuruma prawns	**$194,750**	**$33,750**	**$0**	**$0**	**nil**	**Possible**
3.Environment and technology in the NPF	**$171,251**	**$67,237**	**$3,267,000**	**$1,282,700**	**19:1**	**Probable**
4. Offshore recreational fishing in NSW	**$651,463**	**$183,565**	**Significant non-quantifiable benefits**	**Significant non-quantifiable benefits**	**unknown**	**Probable**

Summary comment

In order to improve the effectiveness of research investment, it may be worthwhile for the FRDC to insist that research applicants provide a more formal analysis of expected net benefits. This would be particularly useful for "industry development-type" projects, such as the spanner crab and kuruma prawn projects considered in this report. We are not suggesting a costly and detailed cost-benefit analysis should be attached to each research application; but rather, taking the kuruma prawn project as an example, we think that an explicit outline of expected costs and benefits (involving researchers and farmers) would likely have raised serious questions about future net economic benefits. After all, anyone interested in acquiring a business loan from a bank is requested to layout explicitly the estimated economic costs and benefits prior to loan approval.

Postscipt

Comments were received from NSC on the analyses in the draft report relating to project number 2 (spanner crabs) and number 3 (kuruma prawns). While agreeing with the outcome of both analyses, the NSC expressed differing views on the potential benefits arising from the kuruma prawns study. In particular, the NSC suggested that some prawn farmers continued to experience substantial, temperature related mortalities, that the cost differential between the new box and existing packaging was only about $1 per unit and, as a result, there are significant potential gains for farmers from using the new box. The non-adoption of the new box is perceived by NSC to be more the result of poor business decision-making by farmers rather than of a lack of real economic incentive to use the box.

The fact that one farmer recently sent two shipments using the new boxes provides some support for this assertion, particularly as the farmer reported that the survival rate of the prawns was better than in previous, end-of-season shipments (using ordinary packaging) and that the Japanese buyers showed no resistance to the new box. Notably, this particular farmer had previously stated that he had no intention of using the new box.

In these circumstances, it is unclear whether kuruma prawn farmers are likely to use the new box in coming seasons. The limited adoption to date and the equivocal attitude displayed by the industry toward the new box underlines the point made in the concluding comments that researchers should be required to put more effort into defining the potential net benefits from their proposed research, and gaining explicit industry support and involvement in the project.

EX-POST COST BENEFIT ANALYSIS OF FOUR FRDC PROJECTS

1. A Brief Outline of Cost Benefit Analysis

First consider the cost/benefit approach followed in evaluating each of the four projects. There are two major components of net economic benefit in cost/benefit analysis - producer's surplus and consumer's surplus. Producer's surplus is a measure of net economic benefits created in the harvesting and processing sector from a specific research project. Although somewhat of a simplified explanation, producer's surplus can be thought of as additional profits generated. As well, if the research findings induce increases in production and employment, then to the extent that previously unemployed labour is employed, the associated wages would also be included as a benefit in producer's surplus.

Consumer's surplus is a measure of net economic benefits to consumers. For example, if a research project induces an increase in production and that in turn results in a decline in prices on the domestic market, then domestic consumers would be better off. Consumer surplus is simply a measure of this improvement in consumer well-being.

In an effort to keep technical jargon to a minimum, economic benefits related to each of the four projects will be discussed in terms of increased profits, wages and other familiar concepts. As well, consumer's surplus is not particularly relevant for any of the four projects evaluated. This is because three of the projects are concerned with products that are mainly exported so any possible gains in consumers surplus will be derived by foreigners. The remaining project is concerned with generating data on the catch of recreational fishers, and has few immediate implications for consumer's surplus. Consumer's surplus is not further considered in this study.

2. Project No: 92/71 Live Transport of Crustaceans in Air: Prolonging the Survival of Spanner Crabs

Research Agency: **International Food Institute of Queensland**

FRDC program: **Industry development**

2.1 Objectives

- To increase knowledge of the techniques required for successful live transport of crabs destined for export or domestic markets.
- To put this knowledge to commercial practice in developing guidelines and protocols.

2.2 Background

The spanner crab fishery commenced in the late 1970s in the Mooloolaba-Caloundra area as an addition to the mud and sand crab fisheries. In the mid-1980s, the fishery expanded into northern New South Wales, with landings from Queensland and NSW totaling roughly 300 tonnes. After landing, crabs were prepared by cooking for the domestic market and, later for the Taiwanese market.

The spanner crab fishery underwent rapid change at the beginning of the 1990s. A live export market to Asia (primarily Taiwan) was developed, significantly increasing the price received by fishers. New fishing grounds around Bundaberg were discovered. High catch rates and prices encouraged the entry of many more vessels, boosting harvest levels from 880 tonnes in 1991 to almost 2,400 tonnes in 1993.

The International Food Institute of Queensland was heavily involved in the initial development of the live export market, making trial shipments of live crabs to Japan and advising commercial operators on live transport and handling techniques. From the outset, a major factor inhibiting realisation of the live export market's full potential was the sometimes high and variable mortality experienced by spanner crabs during transportation and soon after reaching their final destination.

In the early 1990's, the post-harvest handling methods used by fishers and processors were fairly rudimentary. After harvest, crabs were stored dry in baskets on the deck

of boats until returning to shore where the crabs were transferred to live storage tanks in the premises of the crab processors. The crabs were then cooled and stored overnight, prior to packing for export, usually the next day. Therefore, crabs were stored in air twice after harvest: first while on the boat (and sometimes during land transport to processors), and then when shipped by air to export markets.

In response to the live-market mortality problem, FRDC funding was made available initially to study various issues related to spanner crab tolerance when stored in air, with a view to prolonging their survival by developing new in-transit (via air freight) storage methods. The project was subsequently extended to examine the effects of on-board handling on crab mortality and to hold a workshop in late 1993 on harvesting and post-harvest handling of live spanner crabs.

2.3 Research Findings

The research had three components: testing the effects of a buffer formulation during controlled trials and commercial shipments; physiological tests to study the effects on the blood chemistry of the crabs of the buffer and of increased oxygen concentration during shipment; and an examination of the effects on crab survival of changes in post-harvest handling of crabs on vessels and at the premises of processors.

General finding

Initially, attention focused on improving crab survival by improving conditions during air transport. However, as the research progressed, it was thought that on-vessel conditions were probably the major cause of subsequent mortalities. Specifically, the research indicated that, contrary to common perceptions, spanner crabs became quickly stressed when they arrived on deck, and that crabs accumulate large amounts of metabolic waste quickly after leaving the water – their blood pH fell rapidly - a symptom called acidosis.

Air storage during export to market

Two approaches to improving crab survival during air transport were tested. One involved attempts to control the immediate environment of the animals by increasing

the oxygen concentration in the pack; and the other, by dipping the crabs in a bicarbonate buffer solution. It was found that an oxygen-rich atmosphere did not help crabs survive any longer, and may actually reduce survival. With respect to the use of the bicarbonate buffer, it was found that the dip had no significant effect on crab survival.

Air storage after harvest but before processor storage

Crabs were stored on-board vessels using three different methods (in baskets on deck, in cold air, and in live wells) and subsequently held for several days in a recirculating sea-water storage tank to monitor crab survival.

It was found that the use of aerated live wells did not reduce mortality over storing crabs in air. It was suspected that crabs in live wells were more active and, since claws were not bound, fighting led to infections. Crabs that were stored on-board in dry and cool (20°C) conditions showed the best survival. After four days in the storage tank, the mortality of these crabs was roughly 25%, compared to an approximate 56% mortality for crabs stored in baskets on deck.

While not undertaken on vessels, a study was also made of the impact of spraying seawater over crabs stored in air. Results in terms of reduced mortality were not provided, however spraying was found to reduce the fall in blood pH and blood lactic acid concentration. Many boats do not unload at the export premises so a period of road transport is necessary. The research found that while metabolic waste accumulation did not increase as a result of transport, mortality levels did increase from an average of 40% after 4 days without trucking to 65% with trucking.

2.4 Research Recommendations

- Spanner crabs should be stored on boats or transported by road in cool, moist conditions (temperature 16-20°C, 100% relative humidity)
- A practical way should be found to restrain spanner crabs after capture to reduce physical injury when crabs are crowded together - in particular, by banding the claws.

- That crabs stored on-board be subjected to seawater sprays, and that a study should be conducted on the physiological effects of refrigerated seawater sprays when storing crustaceans for long periods because of the questions raised in this study.

2.5 Cost Benefit Analysis

FRDC expenditure: $100,832
Total research cost: $275,749

In simple terms, to undertake the cost benefit analysis, we need to estimate any economic benefits that flow from the research findings. Benefits are then compared to the financial cost of the research, plus any economic costs that are required to capture the benefits.

2.5.1 Potential benefits

The potential benefits from adopting practices that reduce crab mortality are in the form of increased sales and/or increased price. Increased price may result directly from lower mortality in transit or from an improved ability of exporters to "play" the market (as crabs could be held longer in storage) through building up or depleting processor inventories as conditions dictate. A second type of benefit would be in the form of increases in wages earned by fishers and processors that resulted from increased production or increased prices.

2.5.2 Realisation of benefits

Clearly, benefits can only arise if fishers or processors, as a result of the research, change their practices with respect to handling and transporting crabs destined for the live export market. As there are no research recommendations relating to the storage, handling or transportation of crabs by processors, any research benefits must arise as a result of changes in the way that fishers handle their catch.

As noted in Section 2.4, the recommendations of the research are that fishers change from the practice of holding crabs on deck in baskets, to a system under which the crabs are held either in cool, moist air, or in a live well with their claws banded, or

under cool seawater sprays. These recommendations were disseminated to industry via a workshop, held in late1993.

Discussions were held with fishers in the Caloundra-Mooloolaba area of the fishery and with a processor located in Bundaberg to ascertain the extent to which industry has adapted its practices as a result of the research. It appears that most fishers have made only minor changes to their crab handling practices since the early 1990's. Most vessels still carry their crabs on deck, stored in baskets, although they are now often covered with sacking in an attempt to keep the crabs from drying out. In contrast, most of the larger vessels in the fleet, of 45 feet or more, either store their catch in deck boxes or fish holds with ice, or in refrigerated fish holds. However, such vessels comprise only about 10% of the fleet, account for perhaps 15% of the total catch and are concentrated in the northern, Bundaberg area of the fishery. At present, there are no vessels using live wells or cool seawater sprays to maintain the quality of their crabs.

Fishers indicated that the main problems with crab quality arise during the summer months when air temperature is relatively high, and which also coincides with the time when the crabs are weakened as a result of moulting. At these times, a significant proportion of their catch may be judged unsuitable for the live export market and purchased either for freezing "green" or for cooking and export. Fishers in the Mooloolaba area receive about $1/kg less for these crabs than for the crabs that can be exported live. In the Bundaberg area of the fishery, fishers receive only one price for their crabs, irrespective of quality.

The lack of significant changes in crab handling practices by most operators probably reflects both the small average size of the vessels (most are less than 10m) and the associated lack of covered storage space and, importantly, the disincentives for producing high quality product resulting from the limited entry and competitive TAC based management regimes which have been in place in the fishery. Fishers have had incentive to produce quantity rather than quality, and under the current regime have a daily catch limit measured in baskets of crabs – providing incentive to force as

many crabs into a basket as possible. Moreover, with increasing amounts of the year being closed to fishing and daily catch limits being relatively small compared to historic catches, fishers have been "squeezed" financially. This has not been a management "climate" in which investments by fishers to improve crab quality would be likely to take place.

Reinforcing these adverse incentives is the price structure for crabs in the Bundaberg area of the fishery that produces most of the catch. Why bother to look after your catch if you fail to receive a price premium for good quality? Many of the larger vessels, which use ice or refrigerated cool storage, are owned by the processors.

The main crab processor in the Bundaberg area (accounting for around half of live crab exports) stated that the average quality of the crabs coming off the boats has deteriorated since the early 1990's, and that a lower proportion of the catch is now fit for live export. He attributed this quality deterioration to the entry of large numbers of unskilled operators to the fishery since 1991 and to the disincentives and cost pressures faced by industry under the competitive TAC management regime. He did, however, identify that the catches of some operators, using ice or refrigeration were of consistently good quality. But, it was suggested that these vessels would probably have used ice or refrigeration to produce good quality produce in the absence of the research results.

Although there may have been some adoption of the results of the research amongst the larger vessels in the fleet, there would appear to have been few, if any, direct benefits flowing back to these operators due to the single price structure for crabs. Processors may have achieved some benefits by being able to export a higher proportion of crabs than would otherwise have been possible. However, this is unclear, as there has been no overall increase in the proportion of the catch sold on the live export market. Nor has there been any increase in price which might indicate an improvement in the average quality of the crabs being exported. The average in-transit mortality rate for crabs has, apparently, remained around the 5% level since

the early 1990's, and there is no apparent improvement in the ability of processors to play the market through holding the crabs longer.

2.5.3 Costs

The total research cost of the project was $275,749, of which $100,832 was contributed by FRDC. Other potential costs are the expenditures by fishers and processors relating to the implementation of research recommendations. Specifically, these are the costs of installing cold storage facilities, live wells or seawater spraying equipment, plus ongoing costs of ice or refrigerant.

As noted above, although some vessels use deck boxes or fish holds to cool their crabs, many of these vessels already had the necessary storage (for other fisheries in which they were involved), and of those that did not, some would have installed cool storage independently of the results of the research. Remaining expenditures, attributable to the research, are assessed to have been minimal.

2.5.4 Net benefits

The net benefits of this project are assessed as being negative. Overall, it appears that the research has been of little direct benefit to fishers or processors as there has been little adoption of the research findings. This outcome has been driven largely by the lack of incentive for fishers to take care of their catches under the current and previous management regimes.

However, an ITQ system is about to be introduced in the fishery. Both fishers and processors expect that substantial improvements will occur under ITQs with respect to the way in which fishers handle their catches. An anticipated contraction in the fleet, together with an increase in the average size of vessel being used, is likely to lead to greater use of cool storage, either with ice or refrigeration. It was also suggested that live wells would be fitted to some boats, with crabs being held in small baskets in the wells, in a similar fashion to their storage in holding tanks in the premises of processors. Therefore, the introduction of ITQs is likely to lead to greater adoption of the research results and the generation of significant benefits to

both fishers and processors. An evaluation of the results of this research project undertaken in, say, five years time might well indicate a significantly different result.

3. Project No: 92/125.32 Improving Packaging Technology, Survival and Market Options for Kuruma Prawns

Research Agency: **Centre for Food Technology & Bribie Island Aquaculture Centre**

FRDC program: **Industry development**

3.1 Objectives

- To evaluate the temperature stability of a technically advanced live prawn (seafood) package design (prototype and finished item), under a range of storage, transport and climatic conditions.
- To ascertain/confirm the upper lethal temperature limit for Kuruma prawns.
- To determine if modifications to preparation and packaging operations are likely to improve the survival rate of packaged prawns from high ambient temperature growout conditions.
- To establish the potential feasibility of transporting live Kuruma prawns from one location to another to optimise growout conditions and optimise quality through climatic agistment.

3.2 Background

The aquaculture industry producing kuruma prawns in Australia has developed since the late 1980's when the International Food Institute of Queensland (IFIQ) initiated research on the production, packaging and handling of live kuruma prawns for export to Japan. The techniques developed through this research led directly to the development of the Australian kuruma prawn industry. Industry production has grown from 20 tonnes in 1993 to an expected 250 tonnes in 1998, worth around $15 million. A report, in late 1995, on the Kuruma prawn industry by a Austrade official suggested that through increases in quality, appearance and extensions in the

harvesting season, Australian exports could total $100M (1,000 tonnes) by the year 2000.

The original IFIQ research was part funded by FRDC. A cost benefit analysis of this project by ABARE in 1995 indicated that over a 20 year period substantial net economic benefits were likely to be achieved. By the end of 1993-94, the research had already generated benefits equivalent to nearly 90% of research costs.

Until 1995, Australian kuruma prawns consistently attracted high prices (around 80% of those paid for the wild caught Japanese kuruma prawn), attracting new farmers to the industry and leading to increased production. Most of these farms were clustered around the Moreton Bay area, reflecting the fact that the kuruma prawn is a temperate water animal. However, in 1995 a farm in northern Queensland, around Ayr, entered the industry and exported shipments of prawns to Japan. These prawns experienced high mortality rates in transit, damaging the Australian reputation in the Japanese market, and resulting in significantly lower prices for all Australian produced kuruma prawns. Although the northern Queensland farm stopped producing kuruma prawns, prices have remained depressed, although this probably now has more to do with the state of the Japanese economy.

The continued growth in kuruma prawn production, and live export trade, is claimed to be directly linked to in-transit survival and increased production, possibly through the use of more northern Queensland production sites where higher ambient temperatures promote rapid prawn growth. With respect to in-transit survival it is suggested that prices decline if in-transit mortality is greater than 5%. Following the loss in market confidence in the quality of Australian kuruma prawns, a meeting of kuruma prawn farmers in early 1996 agreed on the need for Australian producers to be technically advanced and identified on a country basis as a supplier of quality produce.

In response to concerns about the need to ensure consistent in-transit survival and re-establish market confidence, and to the question of whether northern Queensland

sites could be successfully used for kuruma prawn production, IFIQ proposed the research project with the objectives outlined above.

3.3 Research Findings

There are essentially two components to the research. The first is to develop and test an improved package for the airfreight of kuruma prawns. Second is an examination of whether kuruma prawns can be successfully produced and exported, or send south for climatic agistment, from northern Queensland farms.

Development of an improved live prawn package design

In contrast to the packaging currently used in the industry that comprises a cardboard outer carton lined with seven separate sheets of polystyrene, the new packaging is a single polystyrene unit. It is compact, has superior insulation, greater capacity for coolant adjustments, and is readily identifiable (being both different in nature and coloured blue).

The testing program focused on monitoring temperature changes for various modifications to the prototype package. To test the final prototype, in terms of the effects on prawn survival, five shipments of prawns were dispatched to Japanese markets.

The final prototype was found to have a number of advantages over existing packaging. It can be split into two 3kg units (with suggested marketing advantages), the thermal properties of the package were improved (presumably improving quality and survival) and the general aesthetics of the package were improved (enhancing market acceptability). It was shown to be possible, by adjusting coolants in the package, to compensate for changes in environmental conditions in Japan and Australia, due to seasonal differences between the countries (presumably improving quality and survival).

Determine upper lethal temperature limit for Kuruma prawns

The aim of this part of the study was to determine whether temperatures equivalent to those experienced in ponds located in northern Queensland affected Kuruma prawn survival. The first step was to determine the upper lethal growout temperature. To do

this, kuruma prawns were maintained in laboratory scale tanks and subjected to experimental temperatures of 28°C to 36°C over a four week period.

The study found that, using a laboratory scale system, mortality did not increase significantly until temperatures exceeded 32°C. However, for a number of reasons, the report suggests that temperatures greater than 28°C may cause difficulties. "It is a common experience that Kuruma prawns harvested from ponds in southern Queensland under high temperature conditions (pond temperatures over 27°C) exhibit higher mortalities during live transport than prawns taken from 23°C ponds." The study also found that the breakdown of moult synchronisation as a result of increasing pond temperatures (above 28°C) may have a major bearing on high levels of mortality.

These results cast considerable doubt about the feasibility of producing kuruma prawns in northern Queensland sites where pond temperatures consistently exceed 28^0C during the summer months.

Determine if modifications to preparation and packing can improve the survival rate with respect to high ambient temperature growout conditions

The second step in determining the acceptability of northern Queensland ponds was to examine the potential to modify preparation and packing methods to improve survival from high ambient growout temperature conditions.

The analysis showed a significant decline in post-packing survival as pond temperatures increase from ambient 20°C to 31°C. Survival rates for 20°C and 31°C were 83% and 61%, respectively, on unpacking after 36 hours in dry storage. In an attempt to increase survivability at high ambient temperatures, three preparation and packing modifications were examined. All were thought to be unsuccessful.

Determine the feasibility of transporting live kuruma prawns from one location to another to optimise growout and survival

As an option to increasing in-transit survival of kuruma prawns from warmer climatic conditions, experiments were undertaken to determine the feasibility of

transporting prawns in bulk to alternative sites in cooler areas for optimum growout and "conditioning" prior to export.

Even without control of water temperature or quality, the transport trials, involving 12 hour shipments of kuruma prawns, resulted in 100% survival for all treatments studied. This indicated the technical feasibility of moving the prawns from northern to southern locations for climatic agistment.

3.4 Research recommendations

These "recommendations" are implied from the stated research benefits.

- That the new package be used to commercially airfreight kuruma prawns.
- That year-round production and export from northern Queensland farms is infeasible due to the effects of high ambient pond temperatures on prawn in-transit mortality.
- That production of kuruma prawns in northern Queensland sites during the cooler months, followed by climatic agistment in more southerly sites, is considered for commercial trials.

3.5 Cost Benefit Analysis

FRDC expenditure: $33,750
Total research cost: $194,750

3.5.1 Potential benefits

The new packaging, if used by farmers, could potentially generate benefits to farmers in two ways: in the form of higher profits from increased prices resulting from lower in-transit prawn mortality and growth of market confidence; and through higher wages to farm workers from a prolonged harvesting season. The latter potential benefit would result from farmers being able to take advantage of the improved thermal properties of the packaging to lower in-transit mortality to acceptable levels late in the harvesting season when the ambient temperature difference between Queensland and Japan is greatest.

Re-estabishing Australian kuruma prawns, as a consistently high quality product in the Japanese market appears to be a central underpinning of the project. Along these lines, it is stated in the report that "the Australian product needs to be identifiable as superior and reliable", and that "a technically advanced, universally adopted package which helps guarantee in-transit temperature stability will have a major influence in insuring a stable market position for Australian producers". It was also suggested that the smaller pack size (6kg or 8kg instead of 10kg) would allow access to a greater range of buyers, with the prospect of price increases.

Another potential benefit of the new packaging is through the scope it provides for extending the length of the harvesting season in Australia to take advantage of the higher prices on the Japanese market during the northern summer months. At present, Australian harvests and exports commence around the end of April and continue through to the end of June. Export prices tend to be relatively low at the start of the season and increase toward the season end. Towards the end of the season, cooler harvesting conditions in Queensland coupled with the higher ambient temperatures in Japan often result in relatively high levels of in-transit prawn mortality. Researchers suggested that in-transit prawn mortality of 20-30% was not uncommon at this time. It was suggested that the improved thermal properties of the new packaging should be able to counteract the effects of the international temperature difference and allow the harvesting season to be extended, with farmers benefiting from increased prices.

With respect to the research on the feasibility of kuruma prawn production in northern Queensland, the potential benefits of the research are somewhat long term in nature. First, commercial trials would have to be carried out of growing kuruma prawns in the cooler months in northern Queensland, followed by climatic agistment in southern Queensland and export. If these trials indicated that the practice is economically viable, and if followed by industrial development in northern Queensland, benefits would be generated in the form of profits of the new enterprises and in wages paid to workers.

extra cost of box disposal), it is apparent that their reaction is a strong disincentive for these particular farmers to use the new box.

Although some farmers have apparently attempted to extend the harvesting season to take advantage of higher end of season prices, such trials have been based on the use of current packaging.

3.5.1.2 Costs

The total cost of the research amounted to $194,750, of which FRDC contributed $33,750. As there have been only trial shipments of kuruma prawns using the new box, additional costs are negligible.

3.5.1.3 Net benefits

The estimated net benefits of the project are negative. The lack of benefit is in some ways not surprising, as there does not appear to have been a compelling reason to undertake the box development work in the first place.

It is, however, worthwhile to note that the initial results on the technical prospects for climatic agistment of kuruma prawns grown in northern Queensland might form the basis for future industrial development.

4. Project No: 94/128 "Assessment of the Impact of Environmental Factors and New Technology on the Northern Prawn Fishery"

Research Agency: **CSIRO Division of Fisheries, Cleveland.**

FRDC program: **Ecosystem protection / resource sustainability**

4.1 Objectives

- To identify and quantify possible environmental factors (from meteorological records and satellite-derived data) that might explain the year-to-year variation in catches of the two species of tiger prawn in the NPF.
- To estimate the impact that GPS has had on the effectiveness of fishing effort in the NPF.

4.2 Background

There has been a great deal of speculation about whether tiger prawns in the NPF are over-fished. Two issues that create uncertainty about the current status of stocks relate to environmental factors and the measurement of fishing effort. For example, changes in the environment (such as rainfall) can impact on prawn availability and abundance.

With respect to fishing effort, growing use of global positioning systems (GPS) and plotters can in turn enhance the ability of the fleet to locate and catch prawns. Changes in catch per unit of effort are used as a measure of stock abundance in the NPF. In essence, if vessels are catching more per day than in the past, this is assumed to be an indication that prawn abundance is higher. There are a number of difficulties with using catch per unit of effort (CPUE) as an abundance indicator. For example, if *measured* fishing effort is constant or increasing at a slower rate than *actual* fishing effort, while at the same time catches are increasing, CPUE may falsely indicate that prawn abundance is increasing. Therefore, it is important to obtain a measure of effective fishing effort which is, of course, influenced by the use of new technologies such as GPS and plotters.

Since the NPF is managed using input controls, whereby harvest levels are constrained through area and seasonal closures, and restrictions on gear usage and number and size of vessels, increases in fishing effort are, from a management perspective, undesirable and contrary to AFMA's economic efficiency objective. Therefore, information on changes in the level of effective fishing effort are useful to AFMA in meeting this objective.

4.3 Research Findings

- No environmental factors were identified that explain the inter-annual variation in catches of the two species of tiger prawn throughout the NPF. There were, however, significant correlation between recruitment indices and environmental factors in some regions of the NPF for both species of tiger prawns.

- The GPS and plotter system increased the effectiveness of fishing effort in the NPF by 12% after three years of use.

4.4 Research Recommendations

- That a review of the fishing power of NPF vessels be conducted on a regular basis.
- That nominal effort continues to be adjusted by the rate of annual change in fishing power in all future stock assessments.
- That the assumed rate of increase in fishing power remains at 5% per annum.
- That further research is conducted on environmental effects on tiger prawn recruitment by combining the effects of fishing effort in the analysis.

4.5 Cost Benefit Analysis

FRDC expenditure: $67,237
Total research cost: $171,251

4.5.1 Potential benefits

Transforming nominal (measured) fishing effort into effective fishing effort is essential for stock assessment in the NPF. In fact, the results of this transformation essentially "drive" the whole stock assessment model. Specifically, the fact that tiger prawn stocks are thought to be over-exploited is linked directly to increases in effective fishing effort, as nominal fishing effort has been static or declining over recent years.

Given the estimated growth of effective effort of 5% per year (from this research), it is estimated that the fishing mortality on tiger prawn stocks will, by 1999, be 25% higher than the target level that should permit the maximum sustainable yield from the tiger prawn fishery. (While the 5% figure was used in previous stock assessments, it was argued that industry support for continued use of this assumption was wavering until the results of this research were made available.) So, one potential benefit from the research is the economic benefit flowing from increased

tiger prawn catches, if effective effort were to be reduced to the target level allowing the tiger prawn stocks to rebuild. It is estimated that total tiger prawn catch could increase by around 4% compared to the current level in the medium term. At 1996-97 average prices, this would result in an increase in fishery revenue (and profit) of around $2.4 million per year.

Potentially, this is a substantial under-estimate of the benefits of an effort reduction programme in the fishery. This is because the estimate is based only on changes in the total revenue stream from fishing due to an increase in prawn abundance, and does not include the cost savings resulting from a lower level of fishing effort. Specifically, if the number of vessels were to be reduced, or if vessels were to fish less intensively, total fishing costs should fall. Such cost reductions would add to the economic benefits of the research.

4.5.2 Realisation of benefits

In 1999, AFMA intends to implement an effort reduction programme in the NPF, based on the results of the current assessment of the tiger prawn stocks. Discussions with stock assessment scientists and the AFMA Manager of the fishery indicate that the results of this research project were pivotal in assisting AFMA gain industry agreement to the effort reduction programme. Until this research was concluded, industry could not agree on the extent to which effective effort was increasing. Although a previous estimate of effective effort growth, based on data from 1979 to 1986, had indicated a rate of 5% per year, the introduction in the late 1980's of more constraining fishery management measures prompted industry to question the current relevance of this earlier estimate.

As a major effort reduction programme was concluded in the fishery only five years ago, fishers were naturally reluctant to commit to another expensive and disruptive effort reduction. Firming up the estimate of the increase in effective effort gave industry greater confidence in the value of the proposed programme and enabled AFMA to gain their agreement. According to the AFMA Manager and the principal stock assessment scientist, in the absence of the research results, the process of

gaining industry confidence in, and agreement to, the proposed effort reduction programme would probably have taken at least one more year. Therefore, it is assumed that the benefits of implementing the effort reduction programme one year earlier than otherwise, are attributable to the research.

As noted above, there are potentially two types of benefits that may be derived from the effort reduction progamme. The first is from increased income resulting from higher catches as the rate of fishing mortality on the stocks is reduced to the target level. The second is through reductions in the total costs of fishing.

Under the current and proposed management arrangements for the fishery, it is unlikely that the stock will get the opportunity to rebuild and deliver higher annual catches. This is because effective fishing effort will keep increasing, following the implementation of the effort reduction programme. The AFMA Manager estimates that in the short term, an increase of 5% per year is likely to be maintained. Operators will be able to intensify their fishing effort by towing their gear faster (particularly as the amount of gear per vessel has been reduced and the limit on engine size removed) and by spending slightly more time at sea (there is scope for operators to increase their fishing time by an average of around 5% per year). The probable outcome is that the rate of fishing mortality on tiger prawn stocks will grow quickly back to current levels before stocks can rebuild. Consequently, no increases in catches and, hence, revenues are included in this study as research benefits.

However, economic benefits are likely to arise from the reduction in fishing effort. This is because while fishing costs are likely to fall, revenue probably will not as it is estimated that the proposed effort reduction (12.5%) will have no impact on the size of prawn catches (D. Die, personal communication). That is, the same catch could probably be taken with the lower level of effort.

The scale of reductions in the total costs of fishing will depend on the response of the fishing industry to the effort reduction programme. If fishers respond by consolidating their holdings of gear units through purchases from other fishers (the reduction involves a change from A units to gear units and a 10% reduction in the

total number of gear units, as well as some additional seasonal closures), it is likely that a number of vessels will leave the fishery. Already, some vessels have been "bought out" of the fishery and it likely that more will exit before the start of the 1999 season. The AFMA Manager indicates that at least three vessels are likely to leave the fishery prior to 1999, and that three or more vessels will probably leave over the following two years.

Although the departure of these vessels from the NPF would result in a reduction in both the levels of fixed and variable costs in the fishery, there are unlikely to be real savings in fixed costs (unless the vessels are sold overseas or scrapped). As most Australian fisheries are over-capitalised, the opportunity costs of most vessels is close to zero. That is, their redeployment in another fishery is unlikely to increase overall productivity from the resource, so there is no industry-wide benefit from so doing. Therefore, only savings in variable costs will be considered in this assessment.

The variable cost savings are simply the products of the variable costs per vessel in 1996-97, as estimated by ABARE, and the number of vessels which leave the fishery. However, this saving is offset by the additional costs of increasing fishing effort amongst the smaller fleet. As before, effective effort is assumed to rise at 5% per year, increasing some variable cost factors. Specifically, fuel usage is assumed to increase by 5% per year and repairs and maintenance by 2.5%.

As shown in Table 1, the reductions in variable costs resulting from the exit of six vessels results initially in significant increases in fleet profitability. However, these gains are rapidly dissipated by the steady rise in variable costs associated with the growth of fishing effort. Over a five year period, the fishery ends up less profitable than it started in 1998.

However, in the absence of the research, fleet profitability would have been lower still. As shown in Table 2, delaying the implementation of the effort reduction programme for one year (as a result of more protracted negotiations with industry) would have eliminated any prospect of real cost savings compared to the 1997-98

level. This is because the rise in effort in the intervening year more than offsets the cost reductions due to vessels leaving the fishery. Therefore, the estimated economic benefit of the research project is estimated as the difference between the discounted streams of fishery profits under an effort reduction programme commencing in 1999 and 2000, respectively.

4.5.3 Costs

The total cost of the research was $171,251, of which the FRDC contributed $67,237. There are also costs associated with implementing the effort reduction programme. These relate to additional NORMAC meetings and consultancies amounting to $91,000 over two years for the 1999 effort reduction programme. Delaying the programme one year is assumed to result in additional negotiation expenses of $22,000.

4.5.4 Net benefits

Implementing the effort reduction programme one year earlier than might otherwise have been possible is estimated to result in substantial improvements in industry profitability. Summary statistics are given in Table 3.

Table 3: Summary of research costs and benefits for "Assessment of the impact of environmental factors and new technology on the northern prawn fishery"

Summary results	
NPV of research benefits	$3,267,000
Gains from FRDC investment	$1,282,700
Benefit/cost ratio	19:1

Specifically, discounted economic benefits in excess of $3 million are estimated over the seven year period following the completion of the research. Nearly $1.3 million of these gains are attributable to the FRDC investment. This is equivalent to a benefit/cost ratio of 19:1.

Table 1: Estimated changes in economic returns in the NPF with the research

Year	1995	1996	1997	1998	1999	2000	2001	2002
No. of vessels			127	127	124	122	121	121
Revenue[1]			130,000,000	130,000,000	130,000,000	130,000,000	130,000,000	130,000,000
Total costs			95,097,600	95,097,600	94,176,450	94,026,480	94,681,399	96,178,429
Fleet "profit"			34,902,400	34,902,400	35,823,550	35,973,520	35,318,601	33,821,571
Fleet gains			0	0	921,150	1,071,120	416,201	-1,080,829
Research costs	87,351	83,900						
Implementation costs			69,000	22,000				
Net economic gains	-87,351	-83,900	-69,000	-22,000	921,150	1,071,120	416,201	-1,080,829
NPV of research benefits	991,082							

Table 2: Estimated changes in economic returns to the NPF in the absence of research

Year	1995	1996	1997	1998	1999	2000	2001	2002
No. of vessels			127	127	127	124	122	121
Revenue			130,000,000	130,000,000	130,000,000	130,000,000	130,000,000	130,000,000
Total costs			95,097,600	95,097,600	96,454,913	95,567,897	95,463,890	96,178,429
Fleet "profit"			34,902,400	34,902,400	33,545,088	34,432,103	34,536,110	33,821,571
Fleet gains			0	0	-1,357,313	-470,297	-366,290	-1,080,829
Research costs	87,351	83,900						
Implementation costs			69,000	22,000	22,000			
Economic gains	-87,351	-83,900	-69,000	-22,000	-1,379,313	-470,297	-366,290	-1,080,829
NPV of research benefits	-2,275,963							

1. Revenues are assumed to be unaffected by the adjustment program.

COST/BENEFIT ANALYSIS OF THE NATIONAL SEAFOOD CENTRE

Report to the National Seafood Centre Advisory Committee

by

FERM
(Fisheries Economics, Research and Management Specialists)

1 November 1996

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COST/BENEFIT ANALYSIS OF THE NATIONAL SEAFOOD CENTRE

1. INTRODUCTION

The purpose of this report is to provide the National Seafood Centre Advisory Committee and the FRDC Board with an economic evaluation of the National Seafood Centre (NSC) over its first 4 years of operation.

The NSC was established in 1992 as a joint initiative of the FRDC and Queensland Department of Primary Industries (QDPI). The NSC is located within the Centre for Food Technology (CFT) in Brisbane, and employes one full-time staff member - a commercial manager. Its operations are directed and overseen by the National Seafood Centre Advisory Committee (NSCAC).

The FRDC provides an average of $300,000 per year in funding to the NSC. These funds are used to support research projects and cover the costs of the commercial manager. QDPI, through the CFT, provides office space and logistic support valued at $13,500 per year. (This figure is questionable and is discussed later in Section 4.3.) Current FRDC funding expires in June 1997. The underlying objective of this report is to provide the FRDC Board with sufficient information to determine whether it should continue to fund the NSC after June 1997.

The report is divided into three parts: a quantitative cost/benefit analysis of four research projects funded by the NSC; a qualitative evaluation of all functions of the NSC; and a review of NSC location and funding arrangements.

2. COST/BENEFIT ANALYSIS

This section of the report undertakes a cost/benefit analysis of four projects funded in 1994 by the NSC. The four projects to be examined were selected after discussions with the NSCAC. The four projects were chosen on the basis that they were complete and were thought to have produced significant industry benefits. As well, the information gained from the analysis of these projects was used to perform an "indicative" cost/benefit analysis of NSC's expenditures in 1994.

2.1 ANALYTICAL APPROACH

First consider the cost/benefit approach followed in evaluating each of the four projects. There are two major components of net economic benefit in cost/benefit analysis - producer's surplus and consumer's surplus. Producer's surplus is a measure of net economic benefits created in the harvesting and processing sector from a specific research project. Although somewhat of a simplified explanation, producer's surplus can be thought of as additional profits generated. As well, if the research findings induce increases in production and employment, then to the extent that previously unemployed labour is employed, the associated wages would also be included as a benefit in producer's surplus.

Consumer's surplus is a measure of net economic benefits to consumers. For example, if a research project induces an increase in production and that in turn results in a decline in prices on the domestic market, then domestic consumers would be better off. Consumer surplus is simply a measure of this improvement in consumer well-being.

In an effort to keep technical jargon to a minimum, economic benefits related to each of the four projects will be discussed in terms of increased profits, wages and other familiar concepts. As well, consumer's surplus is not particularly relevant for any of the four projects evaluated. This is because two of the projects are concerned with the export of fisheries products and any possible gains in consumer's surplus will be made by

foreigners. The other two projects involve import replacement and are, therefore, unlikely to have a significant impact on consumer well-being. Consumer's surplus is not further considered in this study.

Next consider the overall cost/benefit ratio for ***all*** NSC funded projects in any given year. Ideally, in calculating the overall cost/benefit ratio for the NSC, the economic benefit of each NSC project should be estimated and summed. Total economic benefit would then be compared to NSC project-related costs plus industry research contributions. This approach was not followed, as it was deemed to be unnecessarily costly and time-consuming. As well, many of the projects are not complete and a number of projects are less amenable to quantitative analysis.

In light of the above difficulties, an alternative approach was employed to determine overall NSC project funding effectiveness. Specifically, the economic benefit of each of the four projects was allocated between the NSC and industry based on each party's relative contribution to total project costs. For example, if project A produced $100,000 in economic benefits, and if the NSC contributed 30 per cent of project funding, then $30,000 (30% x $100,000) in benefits was attributed to the NSC. The NSC's share of economic benefit from each of the four projects was then summed and compared to the annual budget of the NSC.

In effect, this procedure assumes zero economic benefit from all unevaluated projects funded in 1994, and examines whether the four evaluated projects by themselves justify total NSC project funding in that year. Clearly, there are likely to be economic benefits from the projects not evaluated; therefore it is important to note that this approach is conservative and likely to produce an underestimate of economic benefits generated from NSC project funding.

2.2 EVALUATION OF SELECTED PROJECTS

2.2.1 Project 1: Development of a process to remove skin from small fish

The objective of this project was to devise a mechanical approach for the removal of skin from Western Australian pilchards (sardines) and anchovies. The manual removal of skin was costly and reduced the competitiveness of an Australian producer, Mendolia Seafoods (Fremantle), with respect to imported anchovy products.

Initially, Mendolia Seafoods produced anchovies for the pizza trade; however, with increasing price competition from imported, lower quality products, and with reduced availability in Western Australia of larger-sized anchovies, Mendolia Seafood production was redirected towards canning pilchards for the higher quality (and higher price) restaurant and supermarket trade. This section examines the economic benefit generated from the introduction of mechanical skin removal on canned pilchards (brand name - Auschovies) produced for these two product markets.

Net Economic Benefits to Date

The economic costs and benefits from mechanical skinning of pilchards for the "Auschovies" restaurant market and the consumer market are detailed in Table 1. Total project costs, including contributions by the applicant amount to $36,300. Production for the restaurant market, which started in 1995, amounts to approximately 18,000 cans per year. Production for the consumer market, commencing in 1996, is expected to total 20,000 cans this year.

The introduction of mechanical skinning did not change production levels for the restaurant market. However the machine increased skinning productivity by 450 per cent; this in turn reduced labour costs and increased profit margins by roughly $1.50 per can. Therefore economic benefits from the restaurant directed product increased by

$27,000 ($1.50 x 18,000) in both 1995 and 1996.

As the displaced labour was re-employed within the factory (on the newly developed "Australian sardine" canning line) there is no economic loss associated with this labour adjustment. However, if labour had become unemployed, lost wages would represent an economic loss and would need to be deducted from the above estimated benefits associated with increased profit (as long as the labour remained unemployed).

The introduction of the skinning machine also allowed the development of the consumer packs for sale in supermarkets. Therefore, all profits associated with this product should be considered as economic benefit. With profit margins of $0.17 per can, the profit associated with this product line amounts to $3,400 (20,000 cans x $0.17 per can).

Total benefits to date from both products amount to $57,400. The discounted value (at 10 per cent) of these benefits is $46,000. Given project costs of $36,300, this gives a benefit/cost ratio of 1.3 to date. That is, the project is already estimated to have generated a return of $1.30 for each dollar initially invested in research.

Table 1: Summary of costs and benefits for the pilchard skinning project

PROJECT COSTS	1994	1994-96	1995-20
FRDC Contribution	$22,000		
Other Contributions	$14,300		
Total Project Cost	$36,300		
PROJECT BENEFITS			
(1) Restaurant Market			
Number of cans sold per year	18,000	18,000	18,000
Cost saving per can	$1.50	$1.50	$1.50
Total discounted benefit		$42,600	$106,900
(2) Consumer Market			
Number of cans sold per year	20,000	20,000	20,000
Profit margin per can	$0.17	$0.17	$0.17
Total discounted benefit		$2,550	$10,650
Total discounted economic benefit		$46,150	$117,550
Benefit/Cost Ratio		1.3	3.2

Projected net benefits

To provide a long term perspective on the value of the project, the stream of expected annual net benefits is discounted over the life of the project. However, the life of the production process is uncertain and will be affected by factors such as the price of competing products and market demand, amongst other things.

The following two conservative assumptions are made about the expected volume and value of production: sales to both product markets are held constant, and benefits are calculated only out to the year 2000. As shown in Table 1, under these assumptions, projected net economic benefit over the 1994-2000 period is $117,550, with a benefit/cost ratio of 3.2.

2.2.2 Project 2: Australian canned sardines and canned sardine fillets

According to figures published in 'Retail World', dated December 1994, canned sardines had a sales value of $24m in the Australian market. At that time, all products were imported, some 50% of which were of premium grade.

It was thought that an Australian cannery would have high labour costs and be relatively low in volume, and would have, therefore, to compete in the premium end of the market. Following the development of its 'Auschovy' business and the promotion of Fremantle sardines in the restaurant trade, and the consequent introduction of Australian sardines to the Australian domestic market, it was thought that a further opportunity existed to develop the Australian market by introducing a canned product.

The primary objective of the project was to develop three varieties of canned Australian sardines. The products were to be sold at a comparable price to the premium sardine products in the market.

Mendolias Fremantle Sardine Company estimated that a market potential existed for domestic canned sardine products of 5% in volume and 7% ($1.7 million per year) in value of imports. A 10 per cent share of the canned market would only require 500 tonnes of whole fish supply, and therefore resource supply was not likely to be limiting.

Net economic benefits to date

The primary objective was successfully completed with the preparation of Australian

sardines in olive oil, spring water and Italian style tomato sauce. The economic costs and benefits from canning of sardines for the consumer market are detailed in Table 2. Total project costs, including contributions by the applicant amount to $99,600.

Production, which started in 1996, is expected to reach 420,000 cans this year. In 1997, production is anticipated to increase to 600,000 cans and further increase to 880,000 thereafter. These estimates are based on information provided by Mendolias Fremantle Sardine Company and are roughly consistent with the firm attaining a 7% share of the overall market, as suggested as a target in their initial project documentation.

The benefits shown in Table 2 are divided into two categories: increased profits and benefits to labour. As noted earlier, these labour benefits are the wages earned by people which would otherwise have been unemployed. First, consider the issue of increased profits. Production in 1996 is estimated to be around 420,000 cans with a profit margin of $0.47 per can. This amounts to a profit of $148,310 when discounted back to 1994.

Next consider the benefits to labour. To estimate this value it is necessary to determine the extent to which previously unemployed labour was hired to meet the demands of increased production. In fact, most of the necessary labour for the canning line was newly hired, with the remainder being transferred internally from the 'Auschovies' line following the introduction of mechanical skinning. Therefore, all wages paid to staff on the canning line - minus the amount paid to transferred labour - represent economic benefits. These benefits are included for the estimated average duration of unemployment of unskilled female labour in Fremantle.

Wages, estimated on a per can basis, amount to $0.29. Production to date of 420,000 cans implies a discounted wage bill of $121,800. This figure assumes that all additional labour hired would have otherwise remained unemployed for the entire year. Although the average duration of female unemployment in Western Australia is roughly six months, because the rate of unemployment in Fremantle is roughly double the state-wide average,

it was assumed that the average duration of unemployment in Fremantle is also double the state-wide average. As well, the average duration for unskilled female labour in Fremantle is likely to be higher than the average duration of all female unemployment in the state.

However, as noted earlier, some of the labour used on the canning line was not previously unemployed but, rather, displaced from the production of 'Auschovies'. An allowance was made in the estimate of labour benefits for this internal transfer of labour. The discounted value of wages to date is, therefore, reduced from the above mentioned figure of $121,800 to $71,230. As shown in Table 2, total economic benefits to date amount to $219,540 with a benefit/cost ratio of 2.2.

Table 2: Summary of costs and benefits for the canned sardine project

PROJECT COSTS	1994	1994-96	1994-2000
FRDC Contribution	$18,000		
Other Contributions	$81,600		
Total Project Cost	$99,600		
PROJECT BENEFITS			
Canned sardine products			
Number of cans sold		420,000	3,660,000
Average profit per can		$0.47	$0.28
Discounted profits		$148,310	$624,440
Discounted labour benefit		$71,230	$157,300
Total discounted economic benefits		$219,540	$781,740
Benefit/Cost Ratio		**2.2**	**7.8**

Projected net benefits

The discounted net benefits from the project are also detailed in Table 2. The discounted value of profits projected over the 1994-2000 period amount to $624,440. This calculation assumes that the profit margin per can declines from $0.47, estimated to have been achieved in 1996, to $0.25 from 1997 onwards. (The average profit margin for the entire period is estimated as $0.28 as shown in Table 2). This reduction in profit margin per can is based on an assumed increase in the average buying price of pilchards from 80c/kg in 1996 to $1.00/kg thereafter (based on discussions with Mendolias Fremantle Sardine Company).

The discounted benefits to labour amount to $157,300 over the period 1994-2000. All these benefits are generated in the first three years as the level of production increases - in keeping with the assumption that the average duration of unemployment is one year.

Total discounted economic benefit over 1994-2000 is estimated at $781,740, with a benefit/cost ratio of 7.8.

2.2.3 Project 3: Airfreight of live seafood: an improved packaging system for live western rock lobster

Marketing of western rock lobster has undergone significant transformation over the last 5 years. In particular, the percentage of the catch marketed live has increased from roughly 5 per cent to 27 per cent in 1994/95.

The project proposal suggests that the handling, processing and packaging systems for live exports were developed by industry on a rather ad hoc basis. This proposal was put forward as a means to develop a more structured approach. The objectives of the project were to: survey packaging systems used; examine the impact of a number of physical parameters (such as tempature, humidity and oxygen levels) on live lobster health; determine which packaging systems best cope with these physical parameters; and, communicate the results to industry.

One of the major potential benefits noted in the project was the possible reduction in airfreight costs as a result of modifications to the packaging system. Specifically, it is suggested that the replacement of one litre ice bottles with half litre ice bottles would have reduced the freight bill by around $680,000 in 1993-94 without inducing significant additional lobster mortality. This section of the report examines the extent to which this potential benefit has been realised.

Net Economic Benefits to Date

Table 3 provides a summary of costs and estimated benefits from the project. Net economic benefit was calculated as follows: of the approximately 280,000 cartons of live lobsters shipped annually from Western Australia to south-east Asian markets, it appears on the basis of interviews with the main exporters, that the research had a limited influence on their decisions relating to the weight of the coolant used in airfreight cartons. In particular, the research results convinced only one exporter to change to the half kilo coolant bottle earlier - involving the shipment of 45,000 cartons - than would otherwise have been the case.

Table 3: Summary of costs and benefits from the airfreight of live seafood project

PROJECT COSTS	1994/95
FRDC Contribution	$30,000
Other Contributions	$51,000
Total Project Cost	$81,000
PROJECT BENEFITS	
Number of cartons airfreighted	280,000
Number of cartons with 1/2kg coolant resulting from research	45,000
Per cent shipped by foreign airlines	60%
Savings per carton ($4.60 per kilo/2)	$2.30
Total benefit	$62,100
Benefit/cost ratio	**0.8**

The benefits, in terms of savings in freight cost to exporters, amount to $103,500. However, according to exporters, Qantas and Ansett carry around 40% of the total live lobster freight from Western Australia. Therefore, some of the savings to exporters are offset by losses in freight revenues to Qantas and Ansett. From an Australia-wide perspective, only the savings to exporters from lobsters transported by foreign airlines are counted as economic benefits. Consequently, only 60% of the $103,500 of freight cost savings, $62,100, are real economic benefits to Australia. The research costs associated with the project, $81,000, exceed the estimated benefits, resulting in a benefit/cost ratio of 0.8.

The limited adoption by industry of the results of the project reflect a strong aversion by exporters and buyers to the possibility of incurring higher lobster mortality or reduced quality for what are perceived to be relatively marginal savings with respect to freight costs. It is worth noting that one exporter was using half kilo coolant prior to the research and continues to use that size coolant. As well, some exporters expressed concern that temperature conditions at the points of export and receival vary substantially and unpredictably through the year, a factor which in their view increased unacceptably the risk involved in using smaller amounts of coolant. That is, the additional half kilo of coolant in the one litre bottles was seen as a relatively cheap insurance policy. As there are no apparent intentions by exporters currently using 0.75kg or 1kg coolants to change to 0.5kg coolants, no economic benefits have been calculated beyond 1995.

2.2.4 Project 4: Improvement in post-harvest handling and marketing strategy for blue manna crabs

The objective of this project was to ascertain whether higher prices could be attained by crab fishermen in Cockburn Sound in Western Australia by improving product quality through changes to fishing and handling methods and by marketing their catch of blue

manna crabs outside of Western Australia.

The commercial crab fishery in Cockburn Sound produces around 150-170 mt per year. Fishermen use either bottom set gill nets or pots to catch the crabs which are normally all sold on the Perth market. This market is relatively small and easily saturated with product, causing gluts to occur. Prior to the start of the project, it was reported that the quality of product was either poor or inconsistent.

It was recognised that if the crabs could be held alive after capture, the frequent gluts on the local market could be avoided and that good quality frozen crab could be produced for sale on export and other Australian markets.

Net Economic Benefits to Date

Table 4 provides a summary of the costs and estimated benefits from the project. Economic benefits from the project have been derived by the fishermen and the exporter. The benefits are generated from increased catches and sales of crabs. By helping to convince fishermen to change their fishing method from gill netting to potting and to adopt improved onboard handling techniques, the project resulted in an improvement in the quality of the crabs being sold. This in turn provided scope for the development of export markets for the higher quality products. A trial shipment of 10 tonnes was exported to Japan in 1995 and it is anticipated that exports are likely to exceed 30 tonnes in 1996.

These shipments represent increases in production for Cockburn Sound fishermen. As such, the additional profits associated with the increased catches are attributable to the project. According to fishermen, profits of around $2.50/kg are achievable on the extra catch after allowing for the increased costs of production. The discounted economic benefit to fishermen, therefore, amounts to about $77,000 for the period 1994-96. No benefits have been estimated beyond 1996 because fishermen and exporters have advised that the changes brought about by the project were already in the pipeline and would, in

the absence of the project, have been introduced by industry within two years.

Table 4: Summary of costs and benefits for the blue manna crab project

PROJECT COSTS	1994	1994-96
FRDC Contribution	$22,950	
Other Contributions	$41,940	
Total Project Cost	$64,890	
PROJECT BENEFITS		
Extra tonnage caught and exported	10	30
Exporter's margin per tonne	$1,300	$1,300
Discounted profits to exporter		$40,000
Fishermen's profit per tonne	$2,500	$2,500
Discounted profits to fishermen		$77,000
Total discounted economic benefits		$117,000
Benefit/cost ratio		**1.8**

Economic benefits are also derived by the exporter by virtue of the margin between the export price - less freight, handling and processing costs - and the price paid to fishermen for the crabs. This margin is roughly estimated at $1.30/kg. The discounted benefit derived by the exporter until the end of 1996 is, therefore, estimated as $40,000. Total discounted economic benefits amount to an estimated $117,000, giving a benefit/cost ratio of 1.8.

2.3 COST/BENEFIT ANALYSIS OF TOTAL NSC PROJECT FUNDING

It should be realised that while selecting four projects in a given year and comparing their economic benefits to total project costs for that year is appropriate, this measure cannot

be used to evaluate implicitly project funding effectiveness in any other year.

The four projects evaluated above are projected to generate economic benefits totalling almost $1.1 million. The total research expenditures amounted to $276,473. This represents an overall benefit/cost ratio for these projects of 3.9.

However, not all of the benefits are attributable to NSC expenditures, and must be apportioned based on the relative research expenditures of NSC and the industry applicants. Table 5 provides a summary of the benefits of each project, the share of research expenditures borne by NSC and its corresponding attribution of research benefits.

Table 5: Summary of discounted benefits, NSC funding share and NSC benefit attributions by project

Project	Total discounted benefits	Total research costs	NSC share of costs	NSC attributed benefits
Pilchard skinning	$117,550	$36,300	61%	$71,245
Sardine canning	$781,740	$99,600	18%	$141,278
Lobster airfreight	$62,100	$81,000	37%	$23,000
Blue crabs	$117,000	$64,890	35%	$49,500
overall	**$1,078,330**	**$281,790**		***$276,473***

As shown in Table 5, the total estimated economic benefits from these four projects attributable to NSC funding amount to around $276,000. This substantially exceeds the NSC expenditures on these projects of $92,700, and represents a benefit/cost ratio to NSC of 3.0. In other words, for each dollar invested in these research projects by NSC in 1994, an average return of over three dollars in economic benefits was achieved.

In fact, the return on these four projects was sufficient to cover the annual funding of projects by the NSC. Approximately two thirds of the NSC's yearly budget of

$300,000 is devoted to project funding. The remainder pays the salary and associated costs of the commercial manager and in so doing supports a number of project and industry liaison and networking activities.

Even assuming that all the unevaluated projects produced no economic benefit, and further assuming that half of the cost of the commercial manager position is attributable to project management, the total benefits from the four evaluated projects are sufficient to justify the entire project oriented portion of the NSC budget.

This is a positive result, as it is highly likely that the other projects funded by the NSC in 1994, but not evaluated in this study, would have yielded positive economic benefits. Moreover, it is possible that some other NSC initiatives, relating to industry liaison and networking, may have generated economic benefits to industry which would add to this total. To put this another way, almost the entire budget of the NSC in 1994 is justified on the basis of the results of four projects alone.

3. NEED FOR THE NSC

3.1 AN ASSESSMENT OF NSC RESEARCH LEVERAGE

As part of the evaluation of each project, relevant industry operators were asked whether the research would have occurred in the absence of NSC funding support. It emerged that the NSC funding provided important leverage for two of the four projects - those conducted by Mendolias Fremantle Sardine Company. The company indicated that the research and subsequent production activities would not have taken place without NSC funding.

For the remaining two projects, the live rock lobster airfreight project and the blue manna crab project, the benefits associated with these projects would have occurred in the absence of NSC funding, *but at a later time*. For the live rock lobster project, the benefits

would have been captured by industry without NSC funding around six months later than was the case with NSC funding. For the blue manna crab project this timeframe is likely to have been roughly two years. In essence, the NSC support 'leveraged' the benefits forward in time for these projects.

At least with respect to these four projects, it appears that NSC funding provided important leverage. In other words, the industry benefits would not have been generated or would have been delayed without NSC support.

Generalising this result across all NSC projects is not straightforward. However, it appears from the four projects evaluated in this study that the majority of resulting economic benefits were derived from projects that would not have taken place without NSC funding - as opposed to projects which bring forward the timing of benefits. Leverage clearly varies from project to project and is a matter which should be evaluated carefully by the NSCAC in the project application phase.

3.2 ASSESSMENT OF THE ROLE OF THE NSCAC

The NSCAC comprises a mix of industry, government and technical expertise. A balance of industry representation across states is sought to promote widely the role of the NSC and to provide, where possible, a local contact to assist industry in the development of research applications.

The primary role of the NSCAC is to review research applications and to provide guidance to the NSC on its strategic direction. Since the formation of the NSCAC approximately 70 research applications (an indicator of industry demand for NSC services), seeking total funding of $1.6 million, have been evaluated. Of these, roughly 30 have been approved, involving funding of about $0.8 million.

It is also worth noting that within the set of approved projects are a significant number that were rejected on initial application but subsequently approved. This is largely the

result of the active involvement of the commercial manager and the NSCAC in assisting industry to refocus their applications.

3.3 AN ASSESSMENT OF OTHER NSC FUNCTIONS

In addition to the approximate $200,000 which is committed annually to the funding of research projects, around $100,000 is spent on project administration (including roughly $18,000 for NSCAC meeting costs), industry liaison and industry network development. Examples of activities covered under industry liaison and network development include involvement with: food fairs; the live seafood reference group; airfreight project; as well as one-off activities such as the organisation of the Brisbane Seafood Symposium.

Before assessing these "other activities", it is important first to examine the NSC mandate. The charter of the NSC, as expressed in 'Your Guide to Industry Development, Products and Services', 1996, is 'to foster value adding and product development within the post-harvest sector of the Australian seafood industry, by funding research and development activities'. The mandate is further detailed in a 'flier' provided to delegates of the Seafood Symposium which states 'The role of the National Seafood Centre is to add value to fish and fish products through: planning, funding and managing short-term, market focused, applied research and development; and facilitating the dissemination, adoption and commercialisation of the results of research and development."

The above mandate does not explicitly recognise a role for the NSC in industry liaison and networking. Clearly, liaison and networking are necessary to some extent to raise industry awareness of NSC as a funding source for post harvest research and to foster the development of research applications. However, some of the non-project activities mentioned above imply a broader interpretation of the NSC mandate.

This lack of clarity on the precise role of the NSC creates some difficulties in evaluating the appropriateness and effectiveness of the non-project related activities. More importantly, this lack of clarity could lead the NSC to apply too many resources to non-core activities. In other words, there appear to be no explicit boundaries on the amount of

time which the commercial manager spends on industry liaison and networking.

It is important to draw a distinction between research and development projects and more general development activities such as those undertaken by the Live Seafood Reference Group. This distinction should be explicit in NSC budgeting to allow for the prioritisation of NSC activities. At present, there does not appear to be an accounting process to identify how the commercial manager's time is spent.

Notwithstanding the above comments, some limited indications of the need for and effectiveness of the non-project activities have been gained through a small scale survey of industry. Twenty firms in the seafood industry were selected for the survey from the Seafood Industry Directory 1995-96. A sample was drawn from each state from firms and industry associations categorised as being involved in processing and exporting a range of seafood products.

One indicator of the potential effectiveness of industry liaison and networking activities of NSC is the extent of industry awareness of these activities. As noted in Table 6, the survey revealed that 70% of respondents either did not know of the NSC or were not aware of its role. This may reflect the unstructured and somewhat ad hoc manner in which NSC's involvement in these areas has developed. To see whether these responses were indicative of a broader lack of awareness of fisheries research-related institutions, respondents were also asked if they knew of the FRDC. All respondents affirmed a knowledge of the FRDC.

Table 6: Results of a small scale survey of industry

Firm	Aware of NSC?	Aware of NSC's role?	Aware of AUSEAS?	Aware of AUSEAS' role?	How are research needs met?	Any other comments on NSC or government involvement in post harvest matters?
NSW						
HJ Heinz	No	No	No	No	With support of parent company.	Industry should cooperate more for lobbying purposes.
Poulos	No	No	Yes	No	Internally.	
Martins Seafoods	No	No	No	No	n/a	Too many organisations to keep up with. Need a single, prominent organisation on post harvest issues for industry to deal with.
Better Choice Fisheries	No	No	Yes	No	Internally and with help from buyers.	
Ruello	Yes	Yes	Yes	Yes	n/a	Inadequate follow up by NSC of projects to foster commercialisation.
WA						
Craig Mostyn	Yes	No	Yes	No	Internally.	Lots of government organisations in the area - don't know what they do.
Nor-west Seafoods	Yes	No	No	No	Through APPA.	

Firm	Aware of NSC?	Aware of NSC's role?	Aware of AUSEAS?	Aware of AUSEAS' role?	How are research needs met?	Any other comments on NSC or government involvement in post harvest matters?
WA seafood	Yes	Yes	No	No	Inhouse or via rock lobster association.	
WAFIC	Yes	Yes	Yes	Yes	Using a variety of government and industry funding sources.	Inadequate industry experience of NSC commercial managers.
Victoria						
Victoria Seafood Merchants Association	Yes	Partly	No	No		NSC not well recognised by industry in Victoria.
Austrimi	Yes	Yes	Yes	Yes	Inhouse, due partly to difficulties in application development and because of the possibility that application information will get out to competitors.	NSC needs hands on experience and needs to move quickly in product development.

Firm	Aware of NSC?	Aware of NSC's role?	Aware of AUSEAS?	Aware of AUSEAS' role?	How are research needs met?	Any other comments on NSC or government involvement in post harvest matters?
Lakes Entrance Coop	Yes	No	No	No	no needs	
Tasmania						
Tiger seafoods	No	No	No	No	Internally.	Discouraged from applying for funding by delays and frustrations with bureaucratic processes.
IF Cleaver	No	No	Yes	No	Internally.	Unaware of NSC live fish group. Need for info sharing.
Queensland						
Oceania seafood International	Yes	No	No	No	n/a	n/a
Queensland seafood marketers association	Yes	Yes	Yes	No	Austrade and trade associations	Aware of live fish group despite this being his core business. Need for government support for post harvest sector.
Raptis	Yes	No	Yes	Yes	Internally.	Funding processes too slow to take advantage of opportunities in the market place.
Australian Fresh	Yes	Yes	No	No	Sometimes internally, sometimes seek	Maintaining intellectual property over research results from

Corporation					government support.	government funding can be a problem.
South Australia						
David Park Export	No	No	No	No	Internally.	

4. STRATEGIC LOCATION AND FUNDING OF THE NATIONAL SEAFOOD CENTRE

4.1 LOCATION OF NSC

As noted earlier, the NSC is located within the Centre for Food Technology (CFT) in Brisbane. The CFT is a commercial unit within the Queensland Department of Primary Industries. The issue being addressed here is whether the NSC should remain located within the CFT or be relocated elsewhere in Australia. Other possible locations for the NSC include food technology centres in Victoria and Western Australia, and the FRDC in Canberra.

There do not appear to be any compelling reasons to move the NSC; in fact, there may be costs in doing so. In addition to the financial costs of any move, the apparently low level of current industry awareness of NSC would probably be further weakened by its relocation.

However, one criticism concerning the location of the NSC was that it creates a bias toward funding projects involving the Seafood Technology Group within the CFT. It appears that roughly 40 per cent of funded projects did in fact utilise the services of the Seafood Technology Group. One cannot draw any meaningful conclusions from this observation, as this is the largest body of expertise in the area of seafood technology in Australia, and would therefore be expected to be heavily involved in NSC funded research.

One location move worth considering is the possibility of housing the NSC within the FRDC in Canberra. Advantages of a move to Canberra include possible efficiencies in project administration; closer proximity to SEAQUAL; and reduced perception of possible funding bias. However, the disadvantage of not being close to seafood

technology expertise and AUSEAS would appear to outweigh these advantages.

4.2 ASSOCIATION WITH AUSEAS

To an outsider, the distinction between NSC and AUSEAS appears somewhat artificial. The advantages of maintaining two distinct groups that are funded by the same two agencies and that service the same client base are unclear - especially in light of the low level of industry recognition of AUSEAS and NSC individually as noted in Table 6.

The services of these two organisations are highly complementary, with AUSEAS often assisting industry in identifying information gaps and possible research projects, that are subsequently developed through the NSC. This raises the question of whether these two groups should be formally integrated with a single governing body. Informal integration already occurs to some extent through the close working relationships developed between individuals in each organisation and via the back up secretarial services supplied by AUSEAS.

It is also worth noting that FRDC funds a substantial portion of SEAQUAL, another organisation with a post-harvest mandate. Although the role of SEAQUAL is somewhat different to the mandates of the NSC and AUSEAS, it may be worth considering whether there would be advantages in closer coordination of the activities of all of these groups. There are already overlaps in the memberships of governing bodies of the three groups. As well, to some extent, the activities of the NSC and SEAQUAL already formally overlap through the operation of the Airfreighted Seafood project which is jointly funded by ASIC, DPIE and FRDC (through the NSC) and informally through the Live Seafood Reference Group. A single governing body could be established to oversee the operations of NSC, AUSEAS and SEAQUAL, with perhaps a formal integration of NSC and AUSEAS. It is worth noting that several industry respondent to the survey stated that they would like to see a single organisation with responsibilities for provision of national post-

harvest services.

4.3 FINANCIAL SUPPORT FROM CFT

Currently the operations of the NSC are funded predominantly by FRDC with some support from the CFT in the form of office space and back up secretarial services supplied by AUSEAS. This support is valued in the current NSC project agreement at $13,500 per year. This figure has recently been recalculated in accordance with QDPI costing policy on overheads for research related activities. The recalculation takes into account the fact that the commercial manager does not use many of the research facilities available at CFT and that financial administration of the project is undertaken by FRDC. This overhead attribution issue is apparently addressed in a forthcoming application from the CFT to FRDC for the continuation of NSC funding.

The issue to be addressed here is whether a larger contribution by the CFT to NSC costs is warranted. This raises the question of what value the CFT derives from housing the NSC. A cursory examination of the projects funded to date by the NSC reveals that around 40% of the NSC funded projects over the last four years have involved the participation of CFT scientists. However, it is important to note that this funding relationship is one of fee for service. The fact that CFT undertakes research on projects funded by the NSC cannot be used to argue for an increase in the CFT funding of the NSC. Benefits flowing from project funding are mutual, in that the NSC receives research information and the CFT receives funds.

Any increase in funding from the CFT for the NSC should, therefore, be based on an explicit identification of services provided by the NSC to the CFT. In light of the move of the CFT toward full cost recovery for CFT services, it would seem particularly important that the financial relationship between the organisations remains on a fee for service basis, especially for public accountability reasons.

4.4 A STRATEGIC ALLIANCE BETWEEN NSC AND CFT

A more formalised strategic alliance between the two organisations would be a positive step in the event that it were agreed to integrate more closely the operations of the NSC and AUSEAS. Any agreement would require re-evaluation of current cost sharing arrangements given that both FRDC and CFT contribute financially to both the NSC and AUSEAS.

5. RECOMMENDATIONS ON FUTURE DIRECTIONS FOR THE NATIONAL SEAFOOD CENTRE

Overall, the operations of the NSC appear to be cost effective on a benefit/cost basis. However, the interpretation of NSC's mandate appears to be broadening over time. This may be appropriate, but it raises questions as to whether the administrative resources are being spread too thinly over too many activities.

It is recommended that an annual breakdown of time spent by the commercial manager on project and various industry liaison/networking activities be provided to the NSCAC to assist in the subsequent prioritisation of NSC operations. The expected outcome of industry liaison/networking activities should also be identified.

There do not appear to be any clear advantages in moving the location NSC at this time, and there may be associated financial and "industry awareness" costs.

It is recommended that the NSC remain located within the CFT in Brisbane.

Financial transactions between the CFT and the NSC have been largely on a fee for service basis. Given the move by the CFT towards full cost recovery, it seems appropriate to maintain this type of financial relationship, noting that overhead attribution to the NSC by the CFT is being reviewed.

It is recommended that financial flows between CFT and NSC be maintained on a

fee for service basis. However, financial contributions of QDPI and FRDC to both NSC and AUSEAS should be reviewed if NSC and AUSEAS were formally integrated.

In the survey of industry players there was a low level of awareness of the NSC and AUSEAS, this fact, along with the complementarity of their roles and funding sources suggests that there may be benefits from their formal integration.

It is recommended that consideration be given to combining the operations of the NSC and AUSEAS.

A number of industry players suggested that there were too many "government" organisations involved in delivery of services to the post-harvest sector. It was difficult for industry to maintain awareness of roles and responsibilities of each organisation.

It is recommended that consideration be given to how the FRDC might promote an evolution towards "one stop shopping" with respect to Commonwealth funded post-harvest services.