Economic Viability of Pipi (*Donax deltoides*) Reseeding

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NON-TECHNICAL SUMMARY

2003/209	ECONOMIC VIABILITY OF PIPI (DONAX DELTOIDES) RESEEDING

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(1) ***OBJECTIVES:***

1. Complete an economic assessment (based upon cost-benefit analysis techniques) of the feasibility of pipi reseeding NSW central coast beaches.
2. Package the economic analysis into a usable format for future use as an 'economic decision tool'.
3. Provide an update on the status of land access, approvals and permits to reseed and harvest in areas included in Marine Parks.
4. Inform CRC "Future Harvest Theme" leader of analysis outcomes.

NON TECHNICAL SUMMARY:

Falling pipi harvests in NSW have led commercial fishers to consider the potential for reseeding local beaches to re-establish pipi supply and look for future growth opportunities. Before such an investment was undertaken, this project sought to establish a sound basis on which a reseeding program could be developed. A preliminary economic assessment was done to demonstrate the feasibility of pipi reseeding and an "economic decision tool" was constructed to assist future reseeding efforts. The key stakeholders were contacted and, where possible, the permits necessary for a pipi reseeding program were obtained. Two key fishery management decisions, central to the model developed, were enacted by the commercial pipi fishers. Finally contact was established with key researchers involved in similar harvest technologies.

Outcomes Achieved

An economic model was constructed that assumed an annual reseeding effort of 28.4 million pipis at 5 mm in size with an expected survival to harvest of 14.1%. This would result in approximately 4 million pipis surviving to harvest. At an average weight of 31 g, the reseeding program is expected to generate in excess of 110 t of additional harvest (the approximate equivalent of the total number of pipis historically harvested annually from Stockton Beach in Zone 4, central NSW – the most productive Beach in NSW and the ultimate target for a reseeding program).

In this analysis, an average price of $17.46 per kg was used based on average monthly prices from the Sydney Fish Market and the local cooperative. Although recent prices have exceeded $40 per kg, it is expected that restoring production will bring the average prices back to between $10 and $20 per kg. Given the average price for pipis, an annual gross revenue of approximately $1.95 million is expected. This represents a benefit cost ratio for pipi reseeding of 3.34:1, which would see initial investment returned in two years.

To allow the economic assessment to be conducted an economic decision tool was developed using MS Excel that allows the manipulation of key variables in a pipi reseeding program. This simple tool can be manipulated by researchers and fishers to test sensitivity to changes in input costs, key biological variables (growth and survival) and market prices. This tool has highlighted the importance of limiting hatchery production costs and ensuring adequate survival in reseeding viability, and will become the basis key "stop/go" milestones in any reseeding program. Using this tool, risk analysis conducted has suggested that the model developed is robust and that a pipi reseeding program, meeting the major criteria outlined, is unlikely to incur economic loss.

Significant progress has been made with respect to fishery management and the permit applications to facilitate a reseeding program. Notably the Shellfish Quality Assurance Association (SQAA) have instituted a minimum size for commercial collection (35 mm) and have introduced a closed season for pipi collection for 6 months of the year. Both measures consistent with the economic model developed. The SQAA has consulted with the key NSW Government departments. A scientific permit for pipi collection has been obtained from NSW DPI. The NSW Marine Parks Authority (MPA) have indicated that there are no foreseeable issues with the research proposed. The MPA has indicated that permits are only for a term of 12 months and that issuing a permit at this time would be premature in terms of any proposed reseeding research schedule. Preliminary contact with NSW NPWS, the final essential consent authority, has indicated that there are no outstanding issues that would need to be addressed and they are currently in receipt of a scientific research permit to undertake a trial reseeding program. The local recreational fishers have been informed and a letter of support has been obtained from the Advisory Council on Recreational Fishing (ACORF).

KEYWORDS: Pipi, *Donax deltoides*; Economic modelling

1. BACKGROUND

The "pipi", *Donax deltoides*, is a common bivalve found on open beaches throughout south eastern Australia. Their life cycle includes a brief larval stage (several weeks) before they recruit to the subtidal and intertidal zones of surf beaches. Pipis can grow to a minimum reproductive size of 3.5 cm within 6 months (Murray-Jones 1999) and can ultimately reach a size of 8 cm. Also known as "Goolwa cockles" in South Australia and "eugari" in southern Queensland, pipis have historically been an important part of the diet of coastal aborigines and are popular with recreational fishers as bait. More recently, pipis have been harvested and sold, particularly to local Asian markets, but significantly reduced supply has seen prices soar to >$40/kg.

For over a decade, the pipi fishery in NSW has harvested between 200 and 400 tonnes/annum valued in excess of $2 million. The bulk of this catch, approximately 200 tonnes/annum, comes from Zone 4, Tuggerah to Crowdy Head on the central and mid-north coasts of NSW. Recently, harvests across the State have fallen, particularly in Zone 4 where less than 20 tonnes were collected in the 2005-06 and 2006-07 seasons. Catch statistics from the Fishermans Cooperative in Newcastle show a rapid decline in pipi catches with 145 tonnes landed in 2005, 127 tonnes in 2006, 39 in 2007 and predictions of less than 15 tonnes in 2008.

Areas of pipi habitat are easily accessed by 4WD. Harvesting is done by hand around the low tide when pipis are buried approx. 10 - 15 cm deep in dry sand. Mechanisation is not allowed and individual harvest rates can reach up to >100 kg/h. There is no associated bycatch, operating costs are minimal and the environmental impacts are negligible.

DPI management is currently based on a limited entry endorsed fishery with strict zoning arrangements. Recreational fishers in NSW are allowed to collect no more than 50 pipis for bait, but not for consumption and it is an offence for them to take pipis away from the beach.

In response to dwindling catches, the body representing Zone 4 pipi fishers (the Shellfish Quality Assurance Association, SQAA) began to investigate remediative measures. Initially, the SQAA implemented self-imposed effective fishery management practices (40 mm minimum size and onsite grading to expedite return of undersized stock) and is negotiating additional measures with NSW DPI (catch limits etc.). In addition, the SQAA intends to investigate the potential to reseed pipi beds.

It is hoped that this reseeding program will follow on from previous research at the Port Stephens Fisheries Institute (PSFI) in the development of production technology for bivalves, in particular scallops and oysters. It will build on previous experience in the development of production techniques for estuarine clams and will integrate well with existing programs for the development of clam hatchery production technology. The project will complement the PSFI hatchery's role in the supply of spat to the pearl and oyster industries and will benefit from current efforts to see establishment of additional commercial hatchery production capacity in NSW.

This program also seeks to avail itself of a unique opportunity to assess pipi reseeding potential. Yagon Beach is an isolated area located within the Port Stephens Great Lakes Marine Park at Seal Rocks in NSW. Yagon is a restricted sanctuary zone, although a concession was secured by the SQAA, which allows exclusive access for the hand-gathering of pipis. This is the only extractive activity allowed on Yagon; no other forms of fishing, recreational or commercial, are allowed and vehicular access is limited to key holders (National Parks & Wildlife Service, Marine Park Authority and the SQAA). In addition, there is an exclusion zone for the northern 2 km of the 8 km beach in which no extractive activity at all is allowed. Areas could be set aside or zoned, as appropriate, for collaborative monitoring or special arrangements for involvement of SQAA members. These characteristics lend themselves to a unique opportunity for pipi reseeding trials and associated research with minimal outside interaction.

The SQAA has acknowledged the challenges faced by a reseeding program and have put in place two critical decision points. Before this project commences:

i) an assessment of economic viability will be undertaken and
ii) an "economic decision tool" will be developed.

This project has been undertaken to complete points i & ii and establish the basis for ongoing research.

2. NEED

Since 2007/2008 the SQAA has been considering a pipi breeding program in order to maintain stocks at an optimum which will accommodate increases in harvest to meet the demands of an expanding market. This, along with an effective management regime, will result in the long term profitably and sustainability of the pipi industry.

Fundamental questions requiring consideration before a breeding program is undertaken include

1) the economic feasibility of a reseeding program
2) the ability to monitor the re-seeding progress and success, and
3) whether or not management measures currently in place will ensure sustainability of the fishery if re-seeding is successful.

Accordingly, this program was proposed and will be used as a critical decision point for further research. In the event of an unfavourable outcome, reseeding research will not be progressed until fundamental changes occur that alter the underlying assumptions of the model developed.

3. OBJECTIVES

1. Complete an economic assessment (based upon cost-benefit analysis techniques) of the feasibility of pipi reseeding NSW central coast beaches.
2. Package the economic analysis into a usable format for future use as an ‘economic decision tool’.
3. Provide an update on the status of land access, approvals and permits to reseed and harvest in areas included in Marine Parks.
4. Inform CRC "Future Harvest Theme" leader of analysis outcomes.

4. RESEARCH AND DEVELOPMENTS

4.1 ECONOMIC ASSESSMENT

Introduction

In response to a significant reduction in the wild harvest of *Donax deltoides* in recent years by commercial fishers, a need was identified to formulate a strategic approach towards the furthering a pipi reseeding program.

The Shellfish Quality Assurance Association is considering collaborative research that would see a breeding program undertaken to stabilise stocks and maintain commercial harvests above 100 t per annum to allow the industry to continue to meet ever expanding market demands. It is hoped that a successful reseeding program coupled with effective management will ensure long term viability for the industry.

Before a reseeding program is undertaken a preliminary cost-benefit analysis was deemed necessary to provide information to decision makers regarding the cost effectiveness of the reseeding program. Cost-benefit analysis is used to organise information to aid decision making about the allocation of resources. In this case, the commitment of FRDC and NSW DPI funds to a pilot scale reseeding program in Zone 4.

Objectives

The objectives of the project are two fold:

1. Complete a **preliminary cost-benefit analysis of the feasibility of pipi reseeding** on NSW central coast beaches (Zone 4); and

2. Package the CBA into a user friendly spreadsheet format for future use as an '**economic decision tool**' (Appendix 5)

Assumptions

Following the CBA, the SQAA will assess the feasibility of pipi reseeding as a measure to address catch variability and improve industry profitability. Increased and stable pipi populations would also directly benefit recreational fishers, among whom pipis are popular bait.

In undertaking the cost-benefit analysis to assess the potential for pipi reseeding a number of assumptions were made.

- Through extrapolation of existing production costs for other bivalves the costs of pipi production will be estimated. The costs associated with the hatchery production of *Donax deltoides* spat is currently not available, and as such, the cost of producing pipi spat at the Port Stephens Research Institute was estimated using the costs of rearing Sydney rock oyster;
- Biological information, such as growth rates and survival data, were estimated from previous pipi research;
- Pricing and market information was derived from both the Sydney Fish Market and

the Newcastle Fishers Cooperative;

- The budget excludes actual labour, fixed and capital costs associated with the hatchery operation at the Port Stephens Research Institute (in-kind support), but rather uses an estimated cost per mm of spat produced;
- The model assumes a project life of 20 years and used a real discount rate of 8% to calculate the net present value (NPV);
- The modelling was based on the following parameters (Table 1), which have been estimated on the basis of the best available information collected from fishery statistics, fisher observations and hatchery experience with other clams.

Table 1: Parameter assumptions for pipi reseeding

Key Assumptions	Value	Rationale
Target harvest	100 tonnes	Based on the mean harvest for Zone 4 over the last ten years. The minimum harvest to date has been 50 tonnes and it is assumed future harvests could fall to this level once in 5% of years.
Price of spat	$0.004 per mm	Based on current commercial sale price of edible oysters of a similar size.
Size at deployment	5 mm	Optimal size yet to be determined, but observations by fishers indicate that having achieved this size subsequent recruitment to the fishery is high.
Size at harvest	50 mm	Mean size selected to increase yields of large and x-large pipis.
Survival to harvest	14.1 %	Based on figures calculated for scallop reseeding, but thought to be appropriate given reported high recruitment of small seed to the fishery.
Time to harvestable size	56 weeks	Estimate derived from growth rates for pipis in NSW.
Average weight at harvest	31 grams	Describes the average weight of harvested pipis across a harvest profile of 10% mediums (20g), 10% large (25g) and 80% x-large (33g).
Average market price	$17.46	Across the range of harvested sizes this average price is based on Newcastle and Sydney Fish Market data prior to recent price increases.

Assessment Methodology

The reseeding project was considered over a 20 year time frame and as such discounted cash flow analysis was used to determine the annual cost of reseeding activities and the likely benefits accruing to the industry.

Discounting reduces a time stream of costs or benefits to an equivalent amount in today's dollars. The single amount calculated using the compound interest method is known as the present value (PV) of the future stream of costs and benefits. The rate used to calculate present value is known as the discount rate (opportunity cost of funds). Refer to the appendix for more information about discounting.

A number of economic indicators were used to evaluate the model farm:

NPV and Equivalent Annual Return

The net present value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows over the life of the project. If the NPV is positive the project is likely to be profitable. When the NPV is converted to a yearly figure it

becomes annualised. In this report the annualised return is called the equivalent annual return. It is a measure of equivalent annual returns generated over the life of the project expressed in today's dollars.

Internal rate of return (IRR)

The discount rate at which the project has an NPV of zero is called the internal rate of return. The IRR represents the maximum rate of interest that could be paid on all capital invested in the project. If all funds were borrowed, and interest charged at the IRR, the borrower would break even, that is, recover the capital invested in the project.

Benefit Cost Ratio

The benefit cost ratio is used to assess whether a project is to be accepted. A project will be accepted when the value of the discounted benefits exceeds the value of its discounted costs. The benefit cost ratio is simply a measure of the total flow of benefits over the life of the project as compared to the flow of costs. If the ratio is greater than one the project is deemed acceptable. In other words, the ratio describes the return per dollar invested; e.g. if the b-c ratio is 1.6 then we can say that for every $1.00 invested in the project or enterprise we get a return of $1.60.

Payback period

Payback period is a measure of the attractiveness of a project from the viewpoint of financial risk. Other things being equal, the project with the shortest payback period would be preferred. It is the period required for the cumulative NPV to become greater than zero and remain greater than zero over the life of the project.

Results

The model assumed an annual reseeding effort of 28.4 million spat at 5 mm in size with an expected survival through to harvest of 14.1%. This would result in approximately four million pipi's surviving to be harvested. At an average weight of 31 g the reseeding program is expected to generate in excess of 110 t of additional harvest.

In this analysis, the operation received an average price of $17.46 per kg based on average monthly prices from the Sydney Fish Market and the Newcastle Fishers cooperative. Prices in the past have exceeded $40 per kg as production has fallen away in recent years, increasing demand. It is expected that restoring production will bring the average prices back to between $10 and $20 per kg. Given the average price for pipis an annual gross revenue of approximately $1.95 million is expected. Table 2 outlines the key statistics arising from the model.

Table 2: Summary statistics

Average annual production (kg)	111,821
Annual industry revenue from reseeding	$1,952,205
Annual hatchery and release cost	$584,208
Hatchery and release cost per kg	$5.22
Expected industry revenue per kg	$17.46

The cost benefit analysis was carried out over a project life of 20 years using discount rate of 8%. The results of the analysis are shown in Table 3.

Table 3: Summary of profitability results

NPV	$13,431,189
Equivalent Annual Return	$1,367,996
IRR	246%
BC Ratio	3.34
Payback Period	2 years

The discounted cumulative cash flow for the model of pipi reseeding is shown in Figure 1.

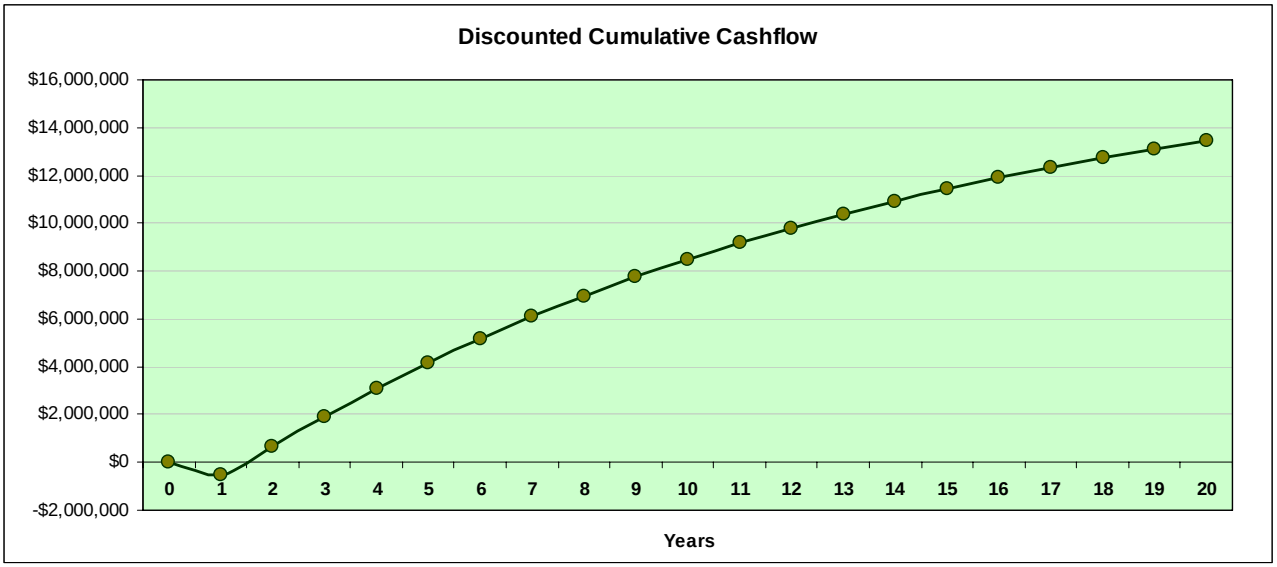


Figure 1: Discounted cumulative cash flow

The largest deficit (peak debt) was incurred by the project in year one. The deficit was approximately $540,000 and comprised the hatchery and release costs required to establish the reseeding program before any harvests would occur from the program. The cash position improved over the life of the project and became positive in Year 2 (payback period).

Risk Analysis

Risk adds a significant degree of complexity to decision making. In the model an estimate of profitability is provided, but what happens to the results under risk? There are endless combinations of factors that will alter estimated production and the price received. We can define the risk we face as exposure to, most commonly, unfavourable consequences.

Accounting for risk will be important in the final determination of the overall benefit of the reseeding program. Production side risk comes from the unpredictable nature of the environment we operate in and the uncertainty about how the crop of reseeded spat will perform once released.

In being able to manage risk there is a need to identify the risks faced (e.g. mortality, lower than expected growth, reduced prices etc) and analyse how these risks occur, assess the impacts they pose, and put in place strategies to minimise their occurrence.

Risk and uncertainty are features of most business and government activities and need to be understood to ensure rational investment decisions. The process involves:

1. Defining your model – *development of reseeding model;*
2. Define our uncertain variables. *These variables are listed in Table 1, and with the exception of spat production cost, will all affect either price or yield and therefore these two parameters have been used in assessing risk;*
3. Assign probability distributions for each of our uncertain variables – *allocating probabilities to our categories of minimum, poor, average, good and maximum;*
4. Run the simulation and analyse the results – *for this risk analysis we have adopted a five point distribution from minimum to maximum based on estimates derived from the available harvest data for the last 10 years. The results are displayed using a cumulative probability distribution.*

In this analysis, the likelihood of various risk factors affecting yield was assessed. In the following table, risk factors such as disease and associated stock losses are considered when applying values to the profile.

Table 4: *Harvest risk profile.*

	kg	Probability	
Minimum	0	0.00	
Poor	50,000	0.05	**5%** chance of getting between **0** and **50** t
Average	90,000	0.30	**25%** chance of getting between **50** and **90** t
Good	105,000	0.70	**40%** chance of getting between **90** and **105** t
Maximum	111,821	1.00	**30%** chance of getting between **105** and **111** t

As the cost benefit analysis model assumes an ideal scenario the risk analysis cites this value as the upper limit, or maximum production possible, although higher productivity is possible. The minimum production output is set at zero to cater for complete failure.

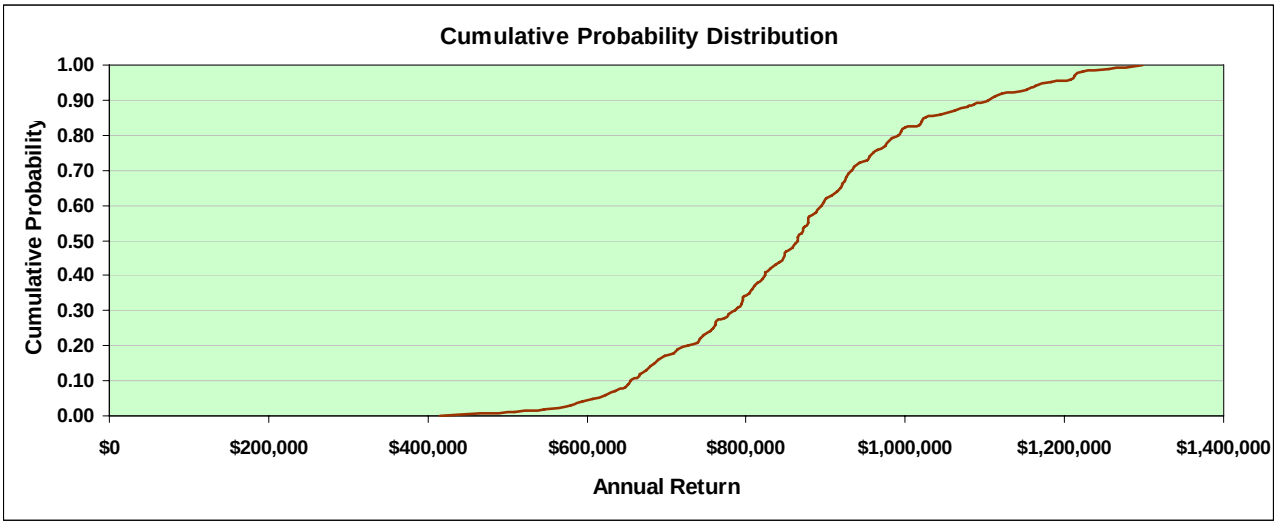
The same process is followed for the price risk, except that the minimum price is not set to zero and maximum prices are not restricted, but the average price achieved in the model will be used to set the average price in the risk analysis.

Table 5: *Price risk profile.*

	$ per kg	Probability	
Minimum	$9.00	0.00	
Poor	$11.00	0.10	**10%** chance of getting between $9.00 and $11.00
Average	$17.50	0.60	**50%** chance of getting between $11.00 and $17.50
Good	$20.00	0.90	**30%** chance of getting between $17.50 and $20.00
Maximum	$40.00	1.00	**10%** chance of getting between $20.00 and $40.00

This following graph shows the entire range of outcomes possible, given the inputs, for the enterprise.

Figure 2: *Cumulative probability distribution.*



The annual return is represented along the x-axis and the probabilities on the y-axis. In the pipi reseeding model for Zone 4 the cumulative probability curve does not cross the $0 return point indicating that minimum possible outcome across the range of production and price risk possibilities is always positive. Table 6 outlines the highest, lowest and average return for distribution.

Table 6: *Range of results for the cumulative probability distribution*

Lowest return	$415,053
Highest Return	$1,298,004
Average Return	$866,054

From the results above, the risk analysis suggests the model is robust in that it is unlikely to incur any economic loss.

4.2 FISHERY MANAGEMENT PROGRESS

The implementation of an authoritative management regime for the pipi industry has been raised as an issue by the Fisheries Research Advisory Board (FRAB) and the board of Fisheries Research & Development Corporation (FRDC) in response to the initial application for funding by the Seafood Quality Assurance Association for the Pipi Reseeding Program.

Concerns the current management, through a system of restricted licensing, is not sufficiently effective in providing industry sustainability is an opinion supported by industry. Accordingly this issue has been the focus of significant effort by the SQAA with several initiatives addressing the problem being undertaken.

As a result of the concerns of the FRDC a special meeting was convened by the SQAA on Friday October 10th to discuss a special resolution in regard to the implementation of a seasonal suspension (closure) of pipi harvesting as a means of allowing every opportunity of success to the Pipi Reseeding Project and supporting the sustainability of the industry.

The resolution received significant support from members and consequently the SQAA will be implementing a seasonal suspension of all harvest site monitoring (water & meat sampling) from the period January 1st 2009 to June 30 2009 on beaches within Estuary Zone 4.

All relevant authorities have been notified of the pending harvest suspension.

It is important to note a DPI Fisheries and NSW Food Authority licensing condition states that pipi harvesting is allowed only on monitored beaches by fishers who are operating according to an approved food safety plan and as such this harvesting suspension is enforceable by DPI Fisheries and DPI Food Authority compliance officers.

It is envisaged that this annual closure will be incorporated into the reseeding strategy of harvest sites in the future and has been incorporated in the financial model developed for this report.

The SQAA has also has been in close dialogue with DPI representatives with a view to implement a minimum size limit for pipis. A proposal has been forwarded to Darren Reynolds, DPI Fisheries Estuary Manager, under whose jurisdiction the pipi harvest industry falls, requesting the introduction of a pipi minimum size limit of 35mm. Ph. D Thesis research completed by Murray Jones (1998) refers to sexual maturity in pipis capable of reproduction at size 27mm. A minimum size limit of 35mm may therefore be considered an acceptable size to allow reproduction to take place prior to individuals being harvested. This limit size may be reviewed (increased) as further information becomes available.

It is envisaged the size limit will be fully implemented by June 30 2009 before the 2009 pipi harvest season commences.

This initiative has the full support of all fishers who are members of the SQAA and its adoption will further support the sustainability of industry by allowing released pipis the opportunity to spawn prior to harvest and consequently support populations of wild and released stocks at spat release sites.

NSW fisheries are currently undergoing the process of full implementation of share management in all fisheries including the Estuary General Fishery under which the management of pipi harvesting falls.

Information from Mr Jim Drinkwater who represents pipi harvesters on the Estuary General Management Advisory Committee (EGMAC) has advised that this will entail the introduction of Total Allowable Catches (TACs) on all species including pipis. We have been advised that the process to full implementation will be completed within 2 years. This timetable will complement the Pipi Reseeding Program and mesh in nicely with the Program schedule.

As the implementation process is currently underway specific detail of the management regime under TACs is not currently available. However it is expected that a weight (kilos) limit associated with the number of shares held in the pipi fishery will be introduced.

This is an important step in securing effective management of the pipi fishery and particularly as an integral management tool available to support the Pipi Reseeding Program and consequently the pipi harvest industry's long term sustainability.

5. BENEFITS

This project has provided a bioeconomic analysis of the potential for pipi reseeding. Through extrapolation of existing production costs for other bivalves, the costs of pipi production has been estimated. This information has been combined with biological information from previous pipi research and pipi market/sales analysis to indicate parameters under which pipi reseeding is feasible. The bioeconomic study has also been used to test the sensitivity of the model to variation in growth and survival and can be used to compare the cost of seed production and reseeding with the GVP of the industry.

In the light of this analysis, the SQAA is encouraged with the potential feasibility of pipi reseeding as a measure to address catch variability and improve industry profitability. Accordingly the SQAA is looking at measures to further research key aspects of the model. The model has established critical decision points for ongoing research and will continue to be used as an ongoing test of reseeding viability.

The analysis developed can now form the basis of an analysis of the potential viability of pipi/clam farming.

This application shares aims similar to those that arise in the Future Harvest theme of the CRC and the outcomes are likely to be of interest to CRC Participants. Accordingly, we have contacted the Theme Leader (Dr Caleb Gardner), and provided a copy of the economic analysis for his consideration.

6. FURTHER DEVELOPMENT

This project was undertaken as a first step in assessing the potential for pipi reseeding to re-establish pipi supply and look for future growth opportunities. The model developed has provided encouragement for the potential to reseed pipis, but has equally highlighted areas in which further research is required. Critically, the cost of production and post seeding survival at particular sizes is central to reseeding success and will be a major focus of any future research. This was envisaged in an initial application to FRDC, but in the light of this analysis will receive greater emphasis and will become the basis of two critical stop/go milestones in any research to be undertaken.

Nursery production costs for pipis in particular are unknown. Here we have used the cost of production for Sydney rock oyster spat as a basis for the model; however, this requires validation. Previous experience with clams (Anadara, Katelysia and Tapes) has indicated that it is likely that hatchery production costs will in fact be cheaper due to shorter larval lives and that existing nursery systems for oysters can be applied. In our experience, clam growth in oyster upwelling systems has eventually slowed. It remains to be seen if oyster nursery systems can be used for *D. deltoides* effectively and at what point if any growth becomes economically unsustainable.

The SQAA has made considerable progress in pipi fishery management reform; however the SQAA will continue to seek reforms and will continue to work with NSW DPI in the development and implementation of Total Allowable Catches (TACs) for pipis.

The SQAA will also continue the process of acquiring the necessary permits to allow trial reseeding to occur. Current applications with NSW NPWS will be pursued and FRDC will be informed when consent has been given.

To acknowledge common themes within the CRC "Future Harvest Theme" and to look for potential synergies in the further development of this research, we have established contact with the Theme leader (Dr Caleb Gardener). Dr Gardner has been provided with copies of the applications for the establishment of a pipi reseeding program and has been given the report on preliminary economic analysis.

The SQAA has established a proposed time line for reseeding research. In the light of this study it has decided that after 18 months it will be necessary to:

iii) have obtained all necessary agreements, permits and approvals for reseeding to occur at Yagon Beach;

iv) have established that hatchery production of pipis is possible;

v) have developed a suitable marking technique to monitor the success of reseeding efforts; and

vi) to have appointed an appropriately-supervised PhD candidate to monitor reseeding.

7. PLANNED OUTCOMES

1) This project has provided a bioeconomic analysis of the potential for pipi reseeding. Through extrapolation of existing production costs for other bivalves, the costs of pipi production were estimated. This information has been combined with biological information from previous pipi research and pipi market/sales analysis to determine the feasibility of pipi reseeding.

2) In the light of this analysis, the SQAA is encouraged by the feasibility of pipi reseeding as a measure to address catch variability and improve industry profitability. Irrespective of the outcome of the assessment, the SQAA would benefit. A negative finding would deter the SQAA from further substantial investment in reseeding options. A neutral finding would elucidate the drivers of economic success and highlight changes required before reseeding would be undertaken. The model developed could then be used as an ongoing test of viability and could be used to establish critical decision points for ongoing research. A positive finding would encourage immediate research investment.

3) The analysis has begun with an assessment of hatchery production costs and has been conducted in a fashion that would allow the models expansion to evaluate of the viability of pipi/clam farming.

4) This report shared aims similar to those that arise in the Future Harvest theme of the CRC and thus the outcomes are likely to be of interest to CRC participants. Accordingly, we have contacted the Theme leader (Dr Caleb Gardner), provided a copy of the application and will keep him informed of progress.

8. CONCLUSIONS

The potential for a pipi reseeding program in NSW to ensure industry survival and increase industry value has progressed significantly. Based on historical market prices for pipis and using the best available information on production costs, bioeconomic analysis has suggested that a pipi reseeding on NSW beaches is potentially viable. Benefit cost ratios of 3.34:1 are expected and risk analysis has suggested that the model is robust and there is limited risk of economic loss.

Fishery reform that would assist pipi reseeding and help assure industry viability has begun and significant steps have been made. In zone 4, minimum sizes have been set and a closed season has been imposed. Key consent authorities have expressed support for the concept of reseeding and progress has been made in the acquisition of the research permits required for reseeding to occur.

Finally key contacts have been established with the relevant Government Departments, Statutory Authorities, the Seafood CRC and Universities that will help progress a pipi reseeding program.

9. REFERENCES

The following have been consulted during the preparation of these models and this report.

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Murray Jones S, Johnson J. 2003. Goolwa Cockle (*Donax deltoides*) SARDI Aquatic Sciences, Adelaide, 54 pp.

10. APPENDICES

10.1 Appendix 1 - Intellectual Property

All information brought into this project or developed during this project is public domain.

10.2 Appendix 2 – Correspondence - Voluntary Closure

Seafood Quality Assurance

S.Q.A.A.

14 Armidale Avenue.
Nelson Bay. NSW.
Australia. 2315
Phone: 02 49 813716
Fax 02 49 813701
Email:
sqaa@bigpond.com

Darren Reynolds
Estuary Manager
NSW DPI
27/11/08

Dear Darren.

I would like to advise that following a special meeting of the SQAA held on Friday 10th October 2008 members have voted in support of a seasonal suspension of Pipi harvesting in Estuary Zone 4 as a means of supporting the sustainability of the industry.

Therefore the SQAA will not be conducting water quality monitoring of Harvest Sites in Estuary Zone 4 during the period January 1 to June 30 2009.

As you are aware DPI licensing conditions state that harvesting is allowed only on monitored beaches and as such the suspension of harvesting is enforceable by compliance officers from DPI Fisheries and NSW Food Authority.

I trust you can appreciate this initiative by fishers who are members of the SQAA as an approach to ensure a viable & sustainable fishery.

Yours Faithfully

Mark Phelps
Co-ordinator SQAA

10.3 Appendix 3 – Correspondence - Size limit

Seafood Quality Assurance

S.Q.A.A.

14 Armidale Avenue.
Nelson Bay. NSW.
Australia. 2315
Phone: 02 49 813716
Fax 02 49 813701
Email:
sqaa@bigpond.com

Darren Reynolds
Estuary Manager
NSW DPI
27/11/08

Dear Darren.

On behalf of Pipi harvesters I wish to put forward a proposal which has been extensively discussed and has the full support of fishers who are members of the SQAA

The Proposal is to introduce a State-wide minimum size limit on Pipis which may be harvested in NSW as a measure to support the sustainability of Pipi stocks on ocean beaches and the viability of the industry.

A size limit of 35mm has been recommended as the animal has been known to be sexually reproductive at that size and as such it would be reasonable to assume that the animal has been actively reproducing. This would be consistent with regulations already in place in other states.

Yours Faithfully

Mark Phelps
Coordinator SQAA

10.4 APPENDIX 4 – MPA CORRESPONDENCE

28th November 08

Marine Parks Authority
NEW SOUTH WALES

Mark Phelps
14 Armidale Avenue
Nelson Bay 2315

Dear Mr Phelps

MPA Permit and Pipi Program, Yagon Beach

Reference is made to your permit application dated 15th September 08 to undertake pipi research, monitoring, and reseeding at Yagon Beach within the Port Stephens-Great Lakes Marine Park (PSGLMP).

Based on our discussions at Port Stephens Research Station on the 25th November 08, it is understood that the component of research proposed for Yagon Beach will not be taking place for at least 12 to 18 months. Because the maximum period available for the granting of a marine parks permit to new applicants is 12 months, I would suggest you lodge your application for the research at Yagon Beach closer to the proposed commencement date.

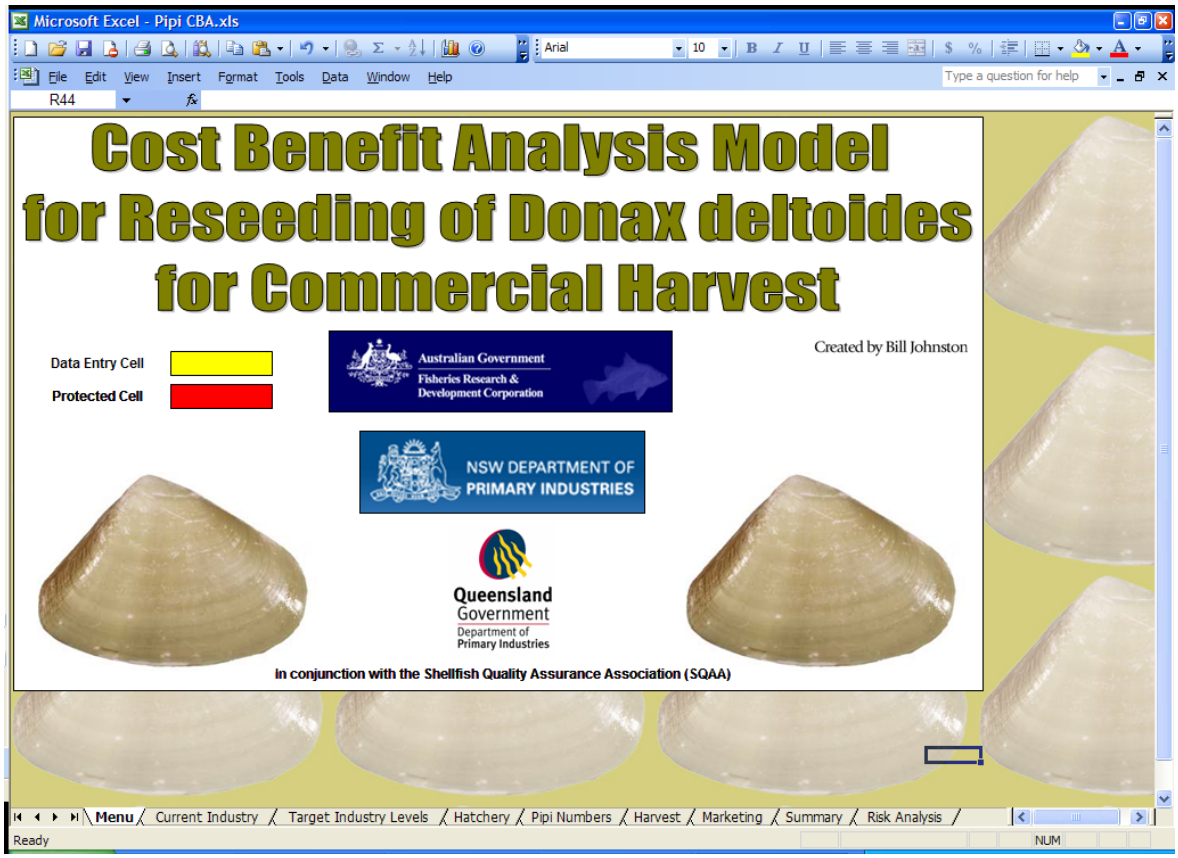
It is also understood that initial collection and reseeding trials will occur at locations on Birubi Beach well outside the PSGLMP, and a permit from the Marine Parks Authority for these activities is not necessary.

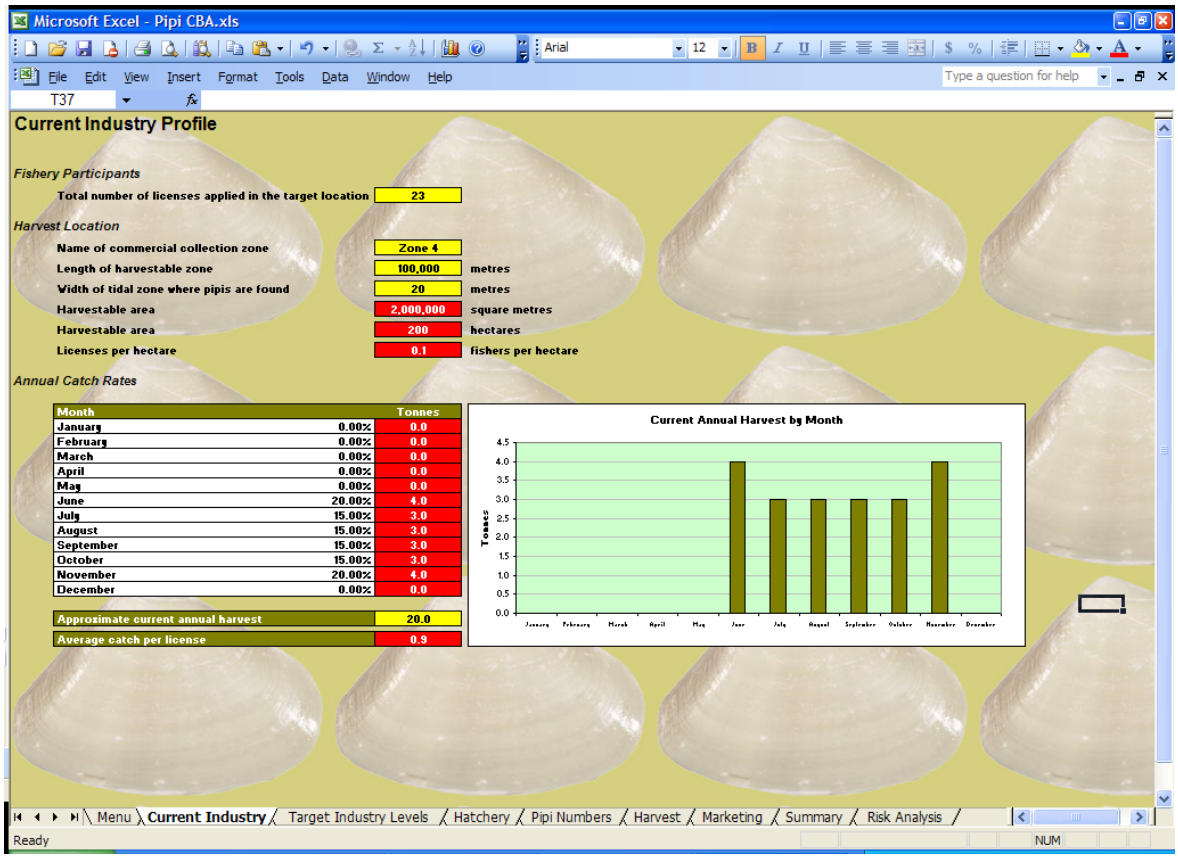
The Marine Parks Authority is always supportive of scientific research that addresses issues of sustainability and enhances the values of the marine park. At present, and based on the information provided, there are no foreseeable issues with the research proposed.

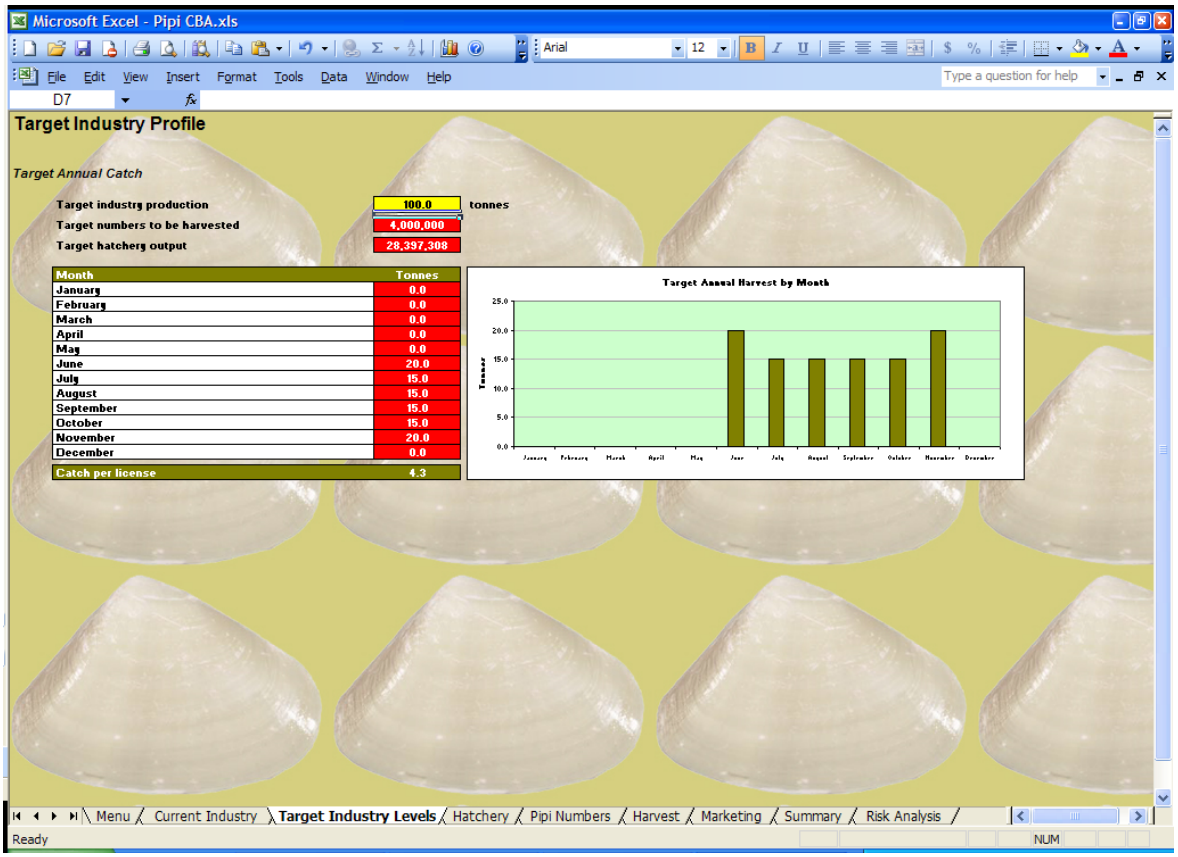
Yours sincerely

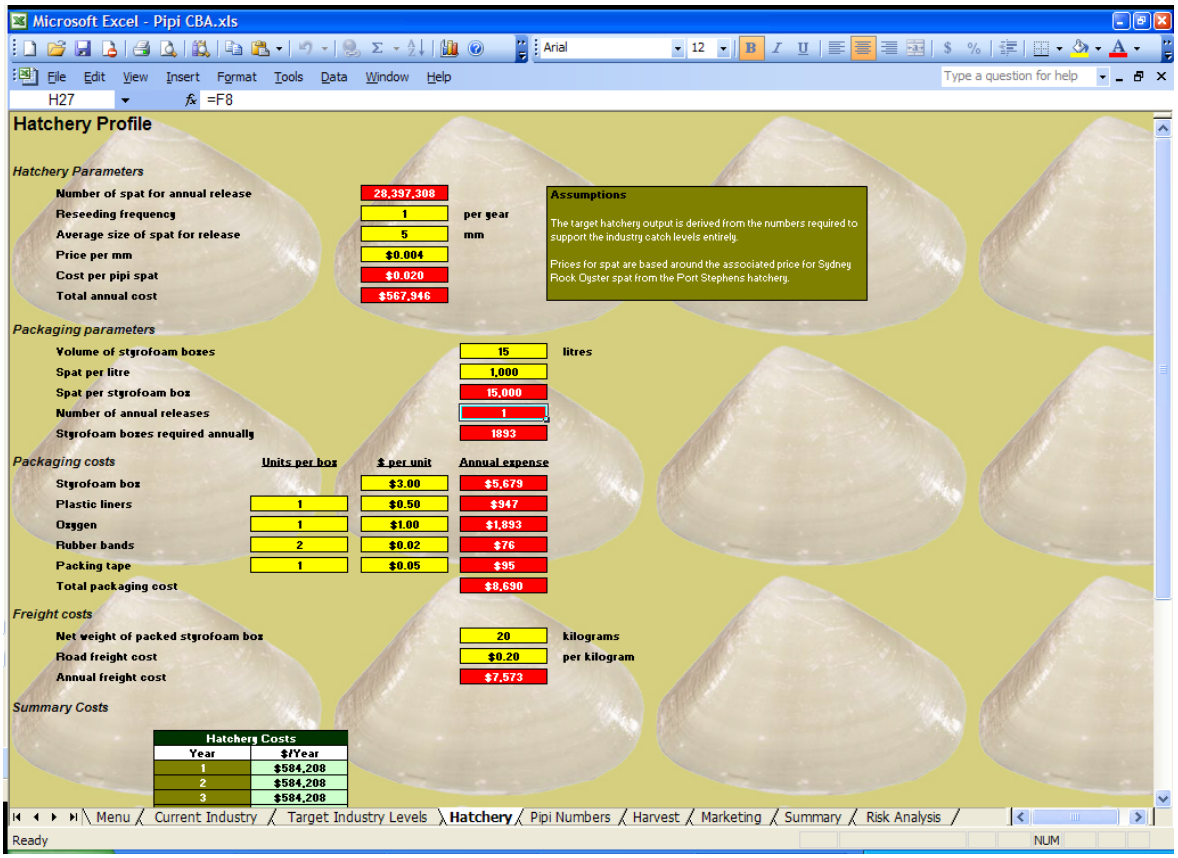
Richard McEvilly
A/Manager
Port Stephens-Great Lakes Marine Park

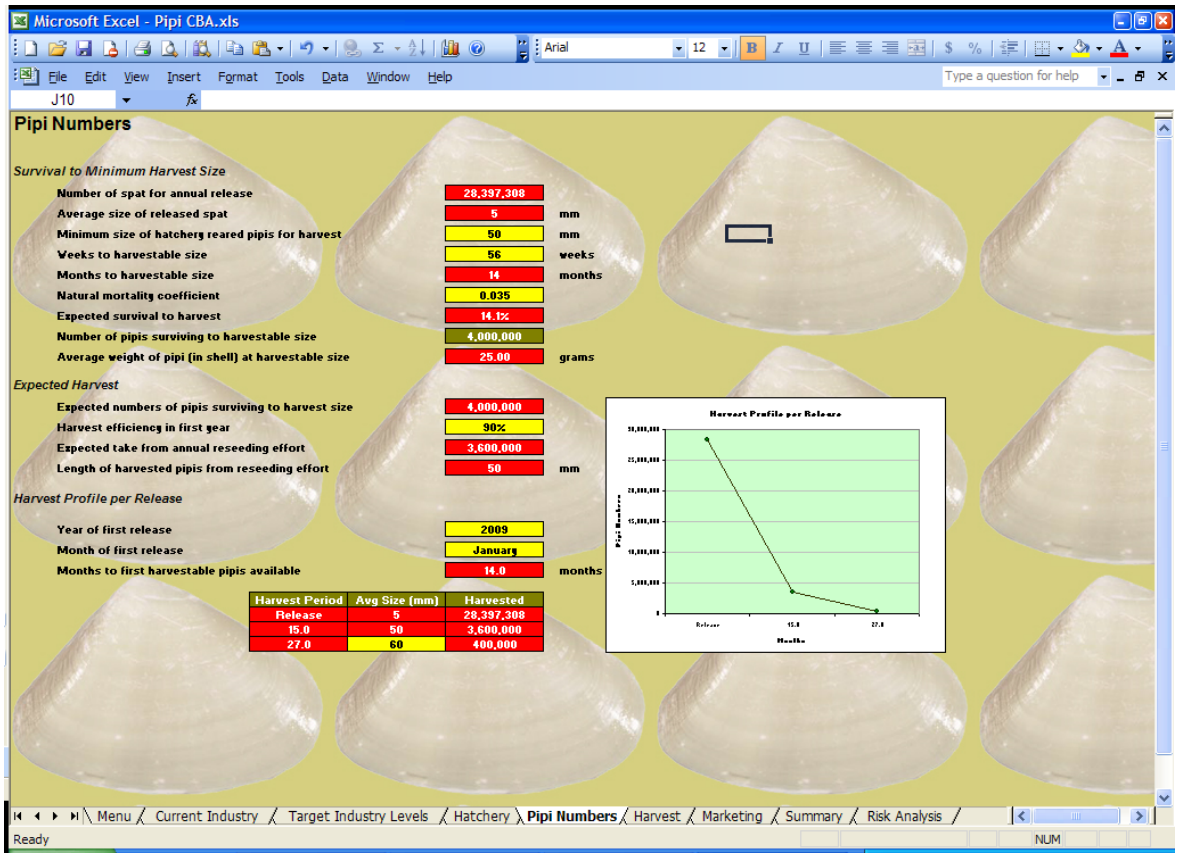
10.5 Appendix 5 – Economic decision Tool (user interfaces)

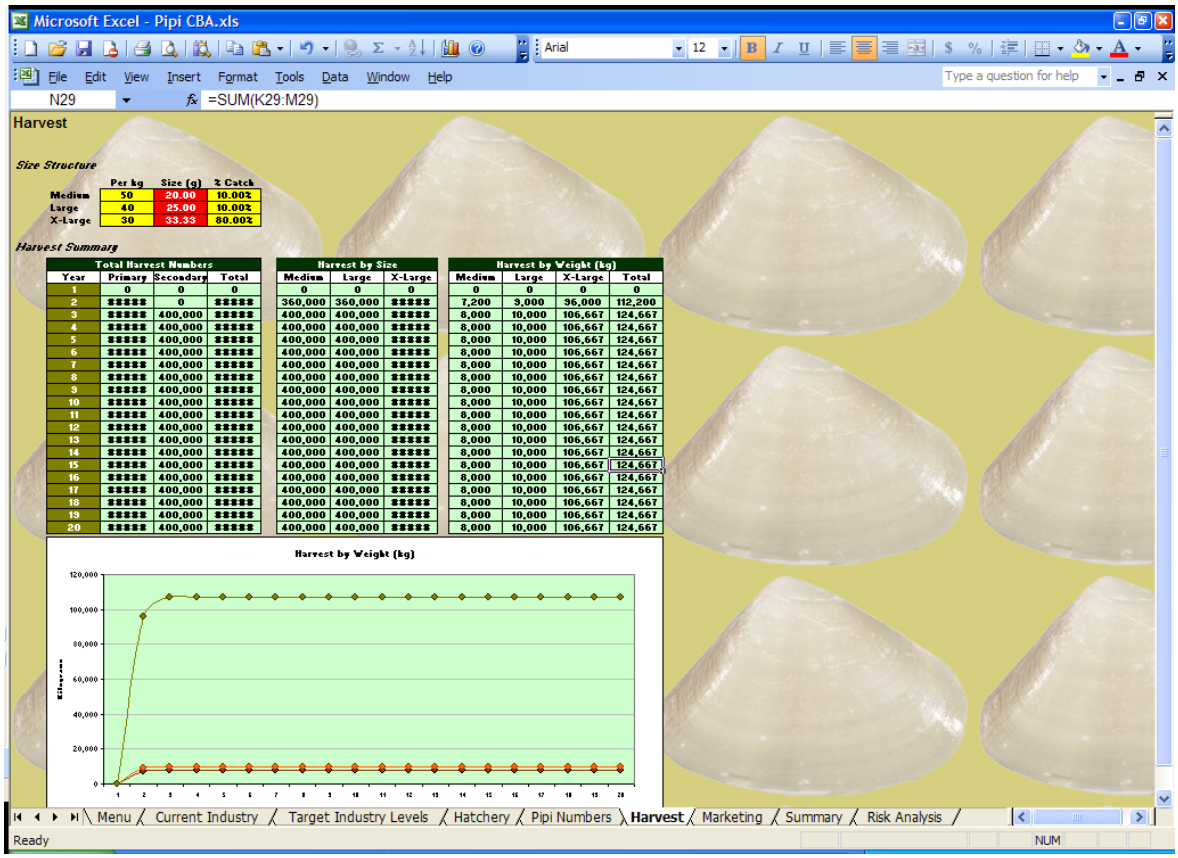


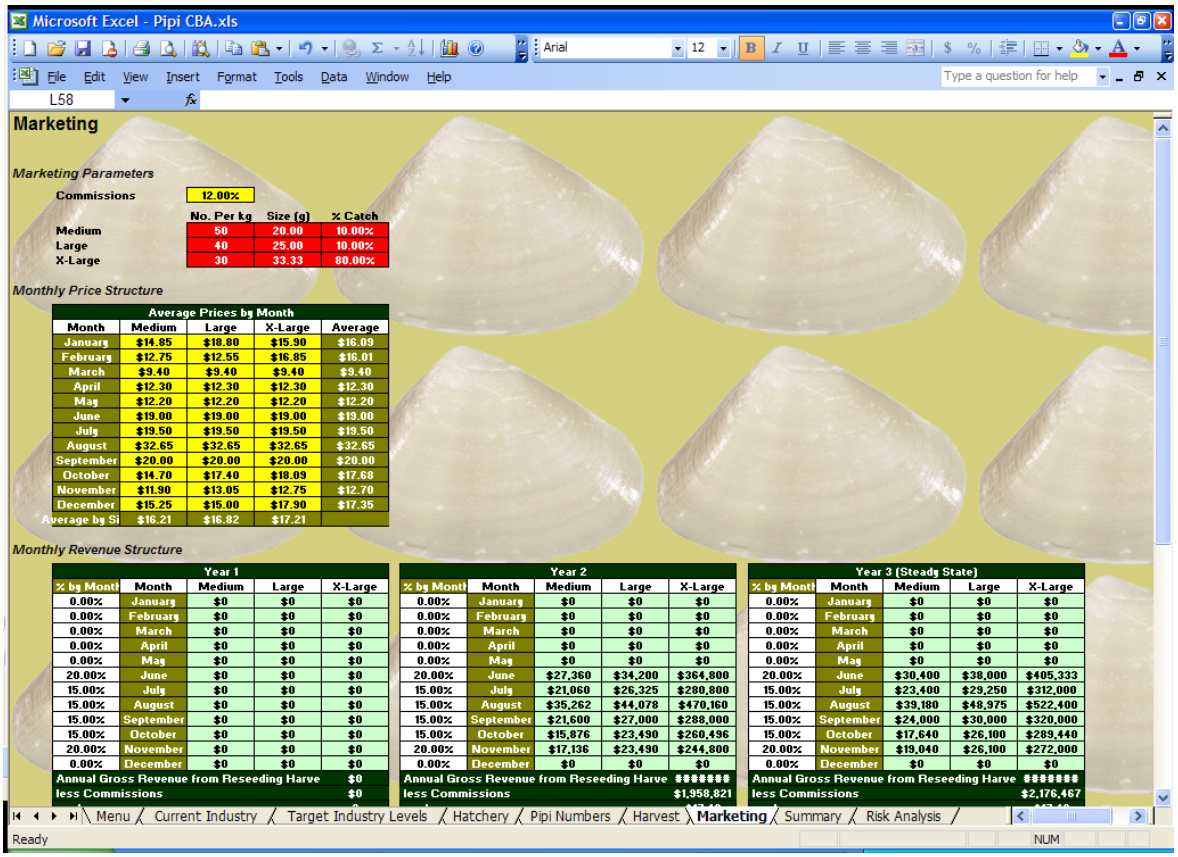


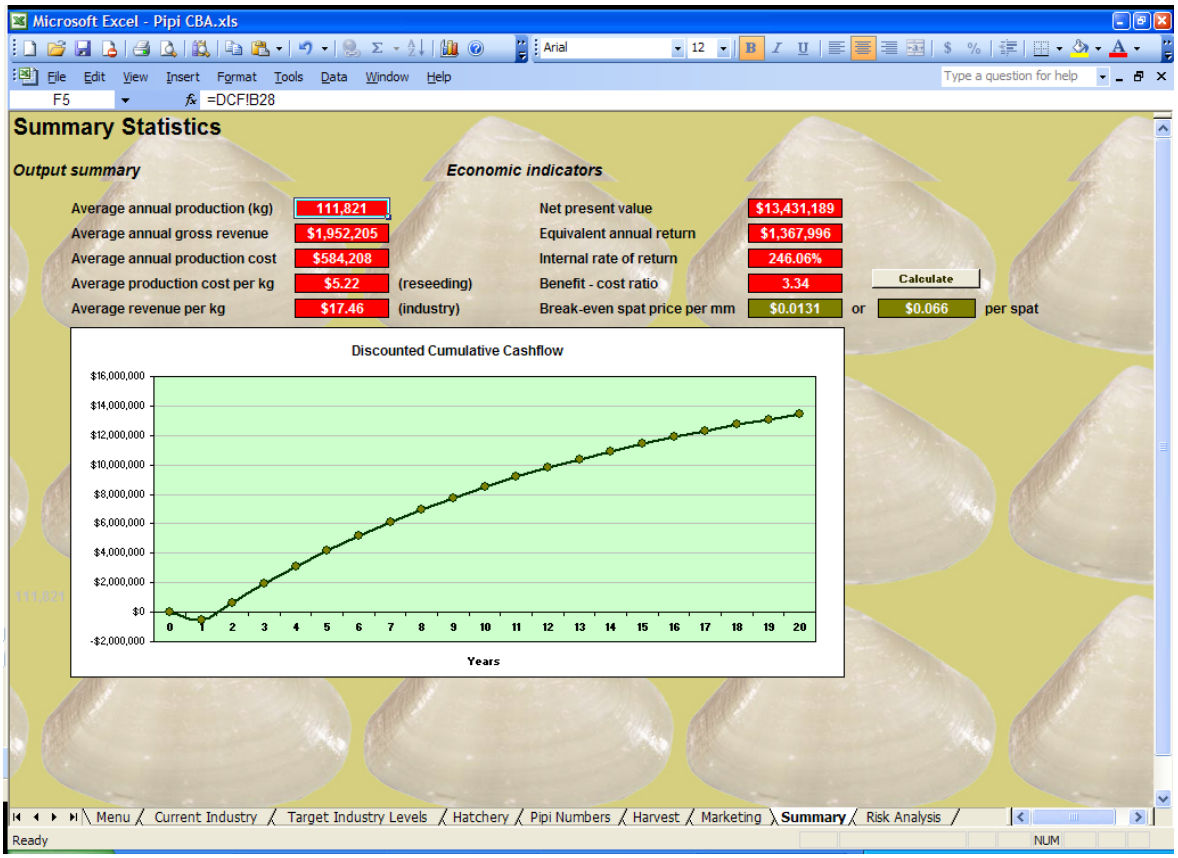

Microsoft Excel - Pipi CBA.xls
Target Industry Profile
Target Annual Catch
Target industry production 100.0 tonnes
Target numbers to be harvested 4,000,000
Target hatchery output 28,397,308
Month Tonnes
January 0.0
February 0.0
March 0.0
April 0.0
May 0.0
June 20.0
July 15.0
August 15.0
September 15.0
October 15.0
November 20.0
December 0.0
Catch per license 4.3
Target Annual Harvest by Month
Tonnes
Menu Current Industry Target Industry Levels Hatchery Pipi Numbers Harvest Marketing Summary Risk Analysis
Ready
NUM

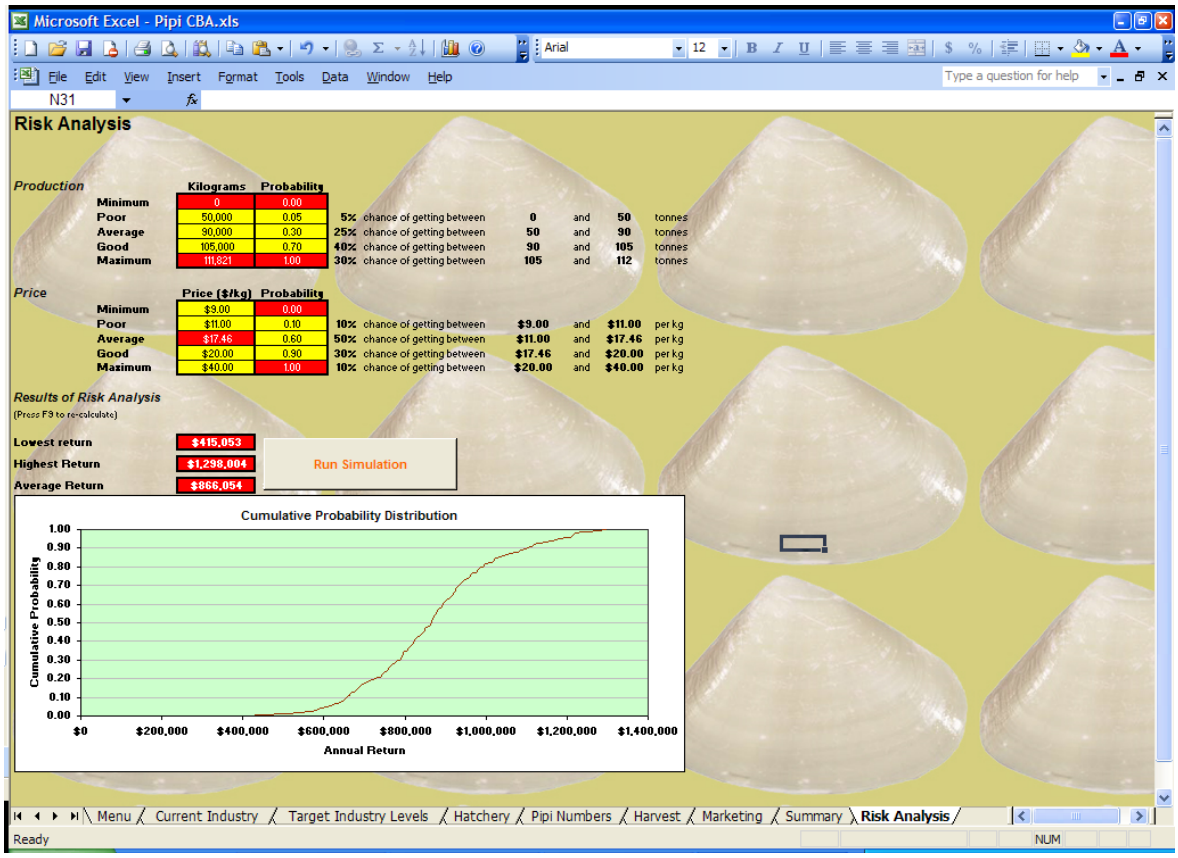

Microsoft Excel - Pipi CBA.xls
Hatchery Profile
Hatchery Parameters
Number of spat for annual release 28,397,308
Reseeding frequency 1 per year
Average size of spat for release 5 mm
Price per mm $0.004
Cost per pipi spat $0.020
Total annual cost $567,946
Assumptions
The target hatchery output is derived from the numbers required to support the industry catch levels entirely.
Prices for spat are based around the associated price for Sydney Rock Oyster spat from the Port Stephens hatchery.
Packaging parameters
Volume of styrofoam boxes 15 litres
Spat per litre 1,000
Spat per styrofoam box 15,000
Number of annual releases 1
Styrofoam boxes required annually 1893
Packaging costs
Units per box $ per unit Annual expense
Styrofoam box $3.00 $5,679
Plastic liners 1 $0.50 $947
Oxygen 1 $1.00 $1,893
Rubber bands 2 $0.02 $76
Packing tape 1 $0.05 $95
Total packaging cost $8,690
Freight costs
Net weight of packed styrofoam box 20 kilograms
Road freight cost $0.20 per kilogram
Annual freight cost $7,573
Summary Costs
Hatchery Costs
Year $/Year
1 $584,208
2 $584,208
3 $584,208
Menu Current Industry Target Industry Levels Hatchery Pipi Numbers Harvest Marketing Summary Risk Analysis
Ready
NUM


Microsoft Excel - Pipi CBA.xls
Pipi Numbers
Survival to Minimum Harvest Size
Number of spat for annual release 28,397,308
Average size of released spat 5 mm
Minimum size of hatchery reared pipis for harvest 50 mm
Weeks to harvestable size 56 weeks
Months to harvestable size 14 months
Natural mortality coefficient 0.035
Expected survival to harvest 14.1%
Number of pipis surviving to harvestable size 4,000,000
Average weight of pipi (in shell) at harvestable size 25.00 grams
Expected Harvest
Expected numbers of pipis surviving to harvest size 4,000,000
Harvest efficiency in first year 90%
Expected take from annual reseeding effort 3,600,000
Length of harvested pipis from reseeding effort 50 mm
Harvest Profile per Release
Year of first release 2009
Month of first release January
Months to first harvestable pipis available 14.0 months
Harvest Period | Avg Size (mm) | Harvested
Release | 5 | 28,397,308
15.0 | 50 | 3,600,000
27.0 | 60 | 400,000
Harvest Profile per Release
Menu Current Industry Target Industry Levels Hatchery Pipi Numbers Harvest Marketing Summary Risk Analysis
Ready
NUM


Microsoft Excel - Pipi CBA.xls
=SUM(K29:M29)
Harvest
Size Structure
Medium 50 20.00 10.00%
Large 40 25.00 10.00%
X-Large 30 33.33 80.00%
Harvest Summary
Total Harvest Numbers | Harvest by Size | Harvest by Weight (kg)
Year | Primary | Secondary | Total | Medium | Large | X-Large | Medium | Large | X-Large | Total
1 0 0 0 0 0 0 0 0 0 0
2 ##### 0 ##### 360,000 360,000 ##### 7,200 9,000 96,000 112,200
3 ##### 400,000 ##### 400,000 400,000 ##### 8,000 10,000 106,667 124,667
4 ##### 400,000 ##### 400,000 400,000 ##### 8,000 10,000 106,667 124,667
5 ##### 400,000 ##### 400,000 400,000 ##### 8,000 10,000 106,667 124,667
6 ##### 400,000 ##### 400,000 400,000 ##### 8,000 10,000 106,667 124,667
7 ##### 400,000 ##### 400,000 400,000 ##### 8,000 10,000 106,667 124,667
8 ##### 400,000 ##### 400,000 400,000 ##### 8,000 10,000 106,667 124,667
9 ##### 400,000 ##### 400,000 400,000 ##### 8,000 10,000 106,667 124,667
10 ##### 400,000 ##### 400,000 400,000 ##### 8,000 10,000 106,667 124,667
11 ##### 400,000 ##### 400,000 400,000 ##### 8,000 10,000 106,667 124,667
12 ##### 400,000 ##### 400,000 400,000 ##### 8,000 10,000 106,667 124,667
13 ##### 400,000 ##### 400,000 400,000 ##### 8,000 10,000 106,667 124,667
14 ##### 400,000 ##### 400,000 400,000 ##### 8,000 10,000 106,667 124,667
15 ##### 400,000 ##### 400,000 400,000 ##### 8,000 10,000 106,667 124,667
16 ##### 400,000 ##### 400,000 400,000 ##### 8,000 10,000 106,667 124,667
17 ##### 400,000 ##### 400,000 400,000 ##### 8,000 10,000 106,667 124,667
18 ##### 400,000 ##### 400,000 400,000 ##### 8,000 10,000 106,667 124,667
19 ##### 400,000 ##### 400,000 400,000 ##### 8,000 10,000 106,667 124,667
20 ##### 400,000 ##### 400,000 400,000 ##### 8,000 10,000 106,667 124,667
Harvest by Weight (kg)
Menu Current Industry Target Industry Levels Hatchery Pipi Numbers Harvest Marketing Summary Risk Analysis
Ready
NUM


Microsoft Excel - Pipi CBA.xls
Marketing
Marketing Parameters
Commissions 12.00%
No. Per kg Size (g) % Catch
Medium 50 20.00 10.00%
Large 40 25.00 10.00%
X-Large 30 33.33 80.00%
Monthly Price Structure
Average Prices by Month
Month Medium Large X-Large Average
January $14.85 $18.80 $15.90 $16.09
February $12.75 $12.55 $16.85 $16.01
March $9.40 $9.40 $9.40 $9.40
April $12.30 $12.30 $12.30 $12.30
May $12.20 $12.20 $12.20 $12.20
June $19.00 $19.00 $19.00 $19.00
July $19.50 $19.50 $19.50 $19.50
August $32.65 $32.65 $32.65 $32.65
September $20.00 $20.00 $20.00 $20.00
October $14.70 $17.40 $18.09 $17.68
November $11.90 $13.05 $12.75 $12.70
December $15.25 $15.00 $17.90 $17.35
Average by Si $16.21 $16.82 $17.21
Monthly Revenue Structure
Year 1
% by Month Month Medium Large X-Large
0.00% January $0 $0 $0
0.00% February $0 $0 $0
0.00% March $0 $0 $0
0.00% April $0 $0 $0
0.00% May $0 $0 $0
20.00% June $0 $0 $0
15.00% July $0 $0 $0
15.00% August $0 $0 $0
15.00% September $0 $0 $0
15.00% October $0 $0 $0
20.00% November $0 $0 $0
0.00% December $0 $0 $0
Annual Gross Revenue from Reseeding Harve $0
less Commissions $0
Year 2
% by Month Month Medium Large X-Large
0.00% January $0 $0 $0
0.00% February $0 $0 $0
0.00% March $0 $0 $0
0.00% April $0 $0 $0
0.00% May $0 $0 $0
20.00% June $27,360 $34,200 $364,800
15.00% July $21,060 $26,325 $280,800
15.00% August $35,262 $44,078 $470,160
15.00% September $21,600 $27,000 $288,000
15.00% October $15,876 $23,490 $260,496
20.00% November $17,136 $23,490 $244,800
0.00% December $0 $0 $0
Annual Gross Revenue from Reseeding Harve #######
less Commissions $1,958,821
Year 3 (Steady State)
% by Month Month Medium Large X-Large
0.00% January $0 $0 $0
0.00% February $0 $0 $0
0.00% March $0 $0 $0
0.00% April $0 $0 $0
0.00% May $0 $0 $0
20.00% June $30,400 $38,000 $405,333
15.00% July $23,400 $29,250 $312,000
15.00% August $39,180 $48,975 $522,400
15.00% September $24,000 $30,000 $320,000
15.00% October $17,640 $26,100 $289,440
20.00% November $19,040 $26,100 $272,000
0.00% December $0 $0 $0
Annual Gross Revenue from Reseeding Harve #######
less Commissions $2,176,467
Menu Current Industry Target Industry Levels Hatchery Pipi Numbers Harvest Marketing Summary Risk Analysis
Ready
NUM


Microsoft Excel - Pipi CBA.xls
Summary Statistics
Output summary
Economic indicators
Average annual production (kg) 111,821
Average annual gross revenue $1,952,205
Average annual production cost $584,208
Average production cost per kg $5.22 (reseeding)
Average revenue per kg $17.46 (industry)
Net present value $13,431,189
Equivalent annual return $1,367,996
Internal rate of return 246.06%
Benefit - cost ratio 3.34
Calculate
Break-even spat price per mm $0.0131 or $0.066 per spat
Discounted Cumulative Cashflow
$16,000,000
$14,000,000
$12,000,000
$10,000,000
$8,000,000
$6,000,000
$4,000,000
$2,000,000
$0
-$2,000,000
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Years
111,821
Menu Current Industry Target Industry Levels Hatchery Pipi Numbers Harvest Marketing Summary Risk Analysis
Ready
NUM


Microsoft Excel - Pipi CBA.xls
Risk Analysis
Production
Kilograms Probability
Minimum 0 0.00
Poor 50,000 0.05 5% chance of getting between 0 and 50 tonnes
Average 90,000 0.30 25% chance of getting between 50 and 90 tonnes
Good 105,000 0.70 40% chance of getting between 90 and 105 tonnes
Maximum 111,821 1.00 30% chance of getting between 105 and 112 tonnes
Price
Price ($/kg) Probability
Minimum $9.00 0.00
Poor $11.00 0.10 10% chance of getting between $9.00 and $11.00 per kg
Average $17.46 0.60 50% chance of getting between $11.00 and $17.46 per kg
Good $20.00 0.90 30% chance of getting between $17.46 and $20.00 per kg
Maximum $40.00 1.00 10% chance of getting between $20.00 and $40.00 per kg
Results of Risk Analysis
(Press F9 to re-calculate)
Lowest return $415,053
Highest Return $1,298,004
Average Return $866,054
Run Simulation
Cumulative Probability Distribution
Cumulative Probability
Annual Return
Menu Current Industry Target Industry Levels Hatchery Pipi Numbers Harvest Marketing Summary Risk Analysis
Ready