Applying economic decision tools to improve management and profitability of sandfish industries in the Asia–Pacific region

Bill L. Johnston[1]

Abstract

A component of the recent Australian Centre for International and Agricultural Research-funded sandfish project in the Philippines, Vietnam and Australia has been to build and refine economic decision tools for both sea ranching and pond-based culture of sandfish. Presented here is the background to these models and some basic theory required to understand model outputs. Models take a discounted cash flow approach to predicting returns over a given life cycle. Output includes the expected annual returns when the farm is paid off, and the maximum interest rate at which funds can be borrowed to invest in the project. A risk module allows the user to incorporate anticipated risk to return from a range of sources. Access to these models is open, and a web address is provided.

Introduction

Sea cucumber farming presents a novel economic proposition as it differs in a number of ways from other aquaculture ventures. When compared with more traditional culture systems, sea ranching presents a unique set of parameters regarding survival, transport and release issues; social and management issues; and exposure to natural system variability. Similarly, pond-based farming differs markedly from culture of other species, most notably in the absence of feeding costs, which is offset in part by low stocking densities. Developing tools based on empirical experience gained through pilot-scale sea ranching and pond-culture projects provides a valuable tool to enable potential industry entrants to assess viability under their particular circumstances.

Economic decision tools are a conceptual framework that allows users to make informed decisions underpinned by sound economic methodology. In this project, cost–benefit analysis was used as the conceptual framework for the economic evaluation of sandfish production. The customised economic tools (industry- or situation-specific) aim to assist producers and potential investors understand the economic requirements, costs and benefits, and risks involved in production.

More specifically, economic decision tools allow producers to assess impacts such as disease, climate and market prices (known as externalities) that may influence profitability. They can also assess changes in profitability caused by changes in the cost of feed, labour, electricity, packaging and transport. Additionally, the decision tools can evaluate the economic effects of improvement in yield, future development plans or a change in production efficiency.

Without rigorous economic decision frameworks, the resulting actions can be based on unsound, incomplete or misleading information. Equipping clients with decision tools provides improved capacity for increased profitability and sound economic development, and reduces the risk of failure.

[1] Department of Employment, Economic Development and Innovation, Maroochy Research Station, Nambour, Queensland, Australia

* Corresponding author: <bill.johnston@deedi.qld.gov.au>

Developing an effective, sustainable and profitable aquaculture enterprise requires a lot of time and capital input. Prevailing market conditions make it very important to thoroughly research and identify markets for products before venturing into production. This applies to almost all industries, particularly aquaculture. Little or no information is available to farmers and interested investors about the establishment costs or the profitability of operating many currently existing sandfish enterprises. By making an economic analysis tool available for farmers, we aim to provide the knowledge and information necessary so that they are fully prepared and understand the capital required, operating costs involved, labour input and profit margins they might expect to receive given an identified level of risk (e.g. the likelihood of losses by cyclones, or fluctuations in market price).

Culture or sea ranching of sandfish is a relatively new income-generating activity (compared with traditional wild harvest) now being practised in a range of countries as an alternative to other income sources. Many people are interested in moving toward more sustainable methods of sandfish production, but do not have enough information to decide whether they are worth doing. They need a way of comparing these new activities with the other, more-familiar activities.

The income, expenditure and investment levels for any business will be different from place to place. Once an economic decision tool framework has been developed for each income-generating activity, it can be distributed relatively easily (electronically) for rural development trainers or extension agents to use with people in an interactive way. Working with farmers to develop data inputs for models relevant to their particular situation will allow comparisons and decisions to be made regarding different income-generating activities.

Project objectives

The economic tools discussed here were developed or modified as a component of the current Australian Centre for International and Agricultural Research (ACIAR) – WorldFish Center project in the Philippines, Vietnam and Australia. The broad economic objectives of the project include:

- diversified livelihoods based on sea ranching of sandfish
- improved livelihood resilience for small-scale pond farmers due to diversification
- increased earnings for fishers from
  - restored stocks of sandfish
  - production of A-grade beche-de-mer through increased size limits and improved processing methods.

The tools discussed are specifically targeted at providing potential industry participants with a window into the economic realities of this type of enterprise. The primary focus has been to look at the possibility of sandfish culture and sea-ranching operations as alternatives to more traditional pursuits. Aquaculture enterprises are usually capital intensive, requiring substantial investment with extended payback periods. The ability of these enterprises to source investment, establish capital infrastructure and weather financial and operating expenses during inception has, in the past, been a major stumbling block for sustainable aquaculture industries. Variability in market prices and income flows also poses major hazards to establishing early profits and ensuring viability in the long term.

The objectives of the modelling component of the project were to:

1. develop three focused economic decision tools, based upon cost–benefit analysis, that people can use to assess the viability of the proposed sandfish enterprise, as follows
   - hatchery–nursery
   - pond-based production
   - sea-ranching production
2. consult with people who are experts in these income-generating activities, and obtain the necessary information to develop representative business frameworks for each enterprise
3. apply and interpret risk analysis profiles for the associated enterprises.

Explanation of the models

The economic models were developed using the Microsoft Excel spreadsheet program and based upon the cost–benefit analysis technique. Cost–benefit analysis is a conceptual framework for the economic evaluation of projects, with an aim to assist the user to make a decision regarding the allocation of resources. In particular, it helps the user to make decisions about whether or not to invest in an enterprise.

Discounted cash-flow analysis was used to determine the annual cost structure and the likely profitability for each of the commodities. Discounting reduces future costs or benefits to an equivalent amount in today's dollars. People generally prefer to receive a given amount of money now rather than the same amount in the future, because money has an opportunity cost. For example, if asked an amount of money they would prefer to receive in 12 months time in preference to $100 now, most people would nominate a figure around the $110 mark—to them, money has an opportunity cost of around 10%. A dollar tomorrow is not worth the same as a dollar today. Therefore, the timing and duration of these projects has an influence on the annualised costs and revenues of the project. 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 PV is known as the discount rate (opportunity cost of funds).

All the models developed assume a project life of 20 years, and use a real discount rate (equivalent to the current long-term bond rate, which is normally in the range 4–10%) to calculate the net present value (NPV). The budgets also incorporate the initial capital and establishment costs.

Data input into the spreadsheet-based models is simple, and is guided by two simple rules—red colour denotes a calculation cell and yellow colour an input cell. Values (size of ponds, cost of labour etc.) can be entered into the yellow cells, while the values in the red cells are calculated from the data entered by the user. The summary statistics provide a breakdown of costs on a per unit basis.

Once the data are entered into the model, the user can apply it to determine the impact of various management decisions. For example, the farmer may wish to know how a change in wages will affect his profit, or how introducing new management techniques will affect production.

All the statistics are explained in the next section. The output includes the expected annual returns when the farm is paid off, and the maximum interest rate at which funds can be borrowed to invest in the project. Once an economic analysis has been done, this maximum interest rate figure should be taken into consideration when negotiating finance for a project.

Definition of terms

Net present value (NPV) and equivalent annual return

The 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, it 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.

Discount rate

The discount rate is the interest rate used in discounted cash-flow analysis to determine the present value of future cash flows. It takes into account the time value of money (the idea that money available now is worth more than the same amount of money available in the future because it could be earning interest), and the risk or uncertainty of anticipated future cash flows (which might be less than expected).

Internal rate of return (IRR)

The discount rate at which the project has an NPV of zero is called the internal rate of return (IRR). It represents the maximum rate of interest that could be paid on all capital invested in the project. In other words, if all funds were borrowed from a bank, and interest charged at the IRR, the borrower would break even; that is, recover the capital invested in the project at the end.

Payback period

A graph representing the cumulative cash flow is displayed in the models. The year in which the cash flow rises above zero is considered the payback period, and 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.

Benefit:cost ratio

The benefit:cost ratio (b:c) is simply a measure of the total flow of benefits over the life of the project compared with 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; for example, if the b:c is 1.6, it can be said that, for every $1.00 invested in the project or enterprise a return of $1.60 is made.

Risk analysis

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

1. defining the model—modelling the business operations
2. defining the uncertain variables—price and yield
3. assigning probability distributions for each of our uncertain variables—allocating probabilities to the categories of minimum, poor, average, good and maximum
4. running the simulation and analysing the results—for this risk analysis, the results are displayed using a cumulative probability distribution.

The best way to demonstrate how to input information for the risk analysis and interpret the results is with an example (Table 1). The user needs to first specify the likelihood of various risk factors (cyclone, theft etc.) affecting production (or yield). In Table 1, 'Risk factors' are listed and then the probability of each of these is stated in the 'Probability' column, with reference to the description in the 'Occurs' column.

As seen in Table 1, data are entered in the 'Probability' column, resulting in the cumulative percentages shown in the 'Cumulative' column. The user then enters the expected production or yield (as in Table 2). It is not necessary to enter the minimum or maximum probabilities, nor their associated production.

This example table indicates that there is a:

- 10% chance of producing 0–20,000 kg (minimum to poor)
- 20% chance of producing 20,000–25,000 kg (poor to average)
- 40% chance of producing 25,000–27,500 kg (average to good)
- 30% chance of producing 27,500–30,000 kg (good to maximum)

The same process is followed for the price risk, except that the minimum and maximum prices are entered by the user. The minimum price cannot be zero; it may be a subsidised price set by the government or a historical market low.

Once all the data have been entered, the simulation is run. The simulation produces a set of results that is graphically shown as a cumulative probability distribution (Figure 1), indicating the entire range of outcomes possible, based on the user's inputs, for the enterprise.

The annual return is represented along the x-axis and the probabilities on the y-axis (Figure 1). In this example, with the costs and prices as specified in the input (yellow) cells, the cumulative probability curve crosses the $0 return point at approximately 0.2. This can be interpreted as meaning that a 20% chance exists of making an annual return of less than $0

Table 1. Expected risks for sandfish farm example

Expected production	Risk factors	Occurs	Probability	Cumulative
Zero–poor	Cyclone, severe disease and flood	1 in 10 years	0.1 (10%)	**0.1**
Poor–average	Theft, some disease, lack of stock supplies	2 in 10 years	0.2 (20%)	**0.3**
Average–good	Good conditions, minimal disease, good feed	4 in 10 years	0.4 (40%)	**0.7**
Good–maximum	Excellent growing conditions, no disease	3 in 10 years	0.3 (30%)	**1.0**

Table 2. Risk input proforma for sandfish farm example

Expected production	Kilograms of sandfish	Cumulative probability
Minimum	0	0.00
Poor	20,000	0.10
Average	25,000	0.30
Good	27,500	0.70
Maximum	30,000	1.00

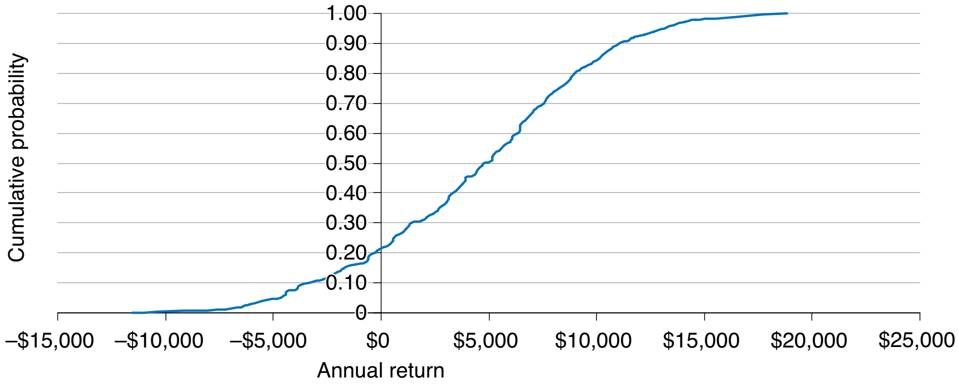

Figure 1. Cumulative probability distribution for sandfish farm example

(i.e. making a loss for the year). Alternatively, a line drawn vertically from the $10,000 mark on the horizontal axis meets the curve at about 0.8 (projecting across to the vertical axis), indicating that there is an 80% chance of earning less than $10,000, and so on.

Should business owners 'pay' themselves?

While identifying costs for inclusion in the economic model framework, there is a tendency for users not to place any value on the time contributed by the owner of the business or the owner's immediate family. Rather, this time and labour is treated as a non-valued good. It is generally assumed that the return to owner labour and management is realised only when the business generates sufficient profit.

The fundamental problem with this way of thinking is that it distorts the decision to undertake that particular enterprise by underestimating the true cost of labour. If the business is able to generate sufficient revenues to compensate owner or family labour, plus all other operating (fixed and variable) and capital expenses, the enterprise would be deemed profitable. If the enterprise returns a profit based solely on unpaid labour, the decision to undertake that enterprise would be based on false economies.

There is a basic requirement to supply food and shelter (subsistence). If the enterprise selected does not meet this need, it should not be undertaken unless it provides a direct food supply to the family.

Consideration must be given to the opportunity cost of labour. An economic value needs to be placed upon the time the business owner and his family devote to the enterprise, so that they can assess whether they are better off to be engaged in that business or in some other economic pursuit. Anybody using these economic models should estimate the cost of that labour, regardless of whether or not actual monies are to be drawn from the business to the owner or their family.

Tool availability and access

These tools have been developed as an open access utility, and are available for download from: <http://agbiz.business.qld.gov.au/>. The tools continue to be refined based on updated empirical information, and new versions may be uploaded periodically.