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An alternative to the value of statistical life and its application to a cost benefit analysis of a fishing emergency rescue system in Oman

Abstract

The fishing industry is one of the most important sectors of Oman's economy in terms of employment, export earnings and food security. Fishing in Oman is mainly a small-scale enterprise activity, accounting for 81 percent of the fish catch. Fishing is a risky activity in Oman, claiming on average 74 lives each year. In this paper, the authors carry out a cost benefit analysis of setting-up a fishing emergency rescue system to reduce the number of fishing fatalities. Traditionally, the value of statistical life (VSL) approach has been used to estimate the benefits in studies like this.

However, the VSL has been criticized in the literature on grounds that: it is difficult to apply in a developing country setting; it leads to results biased upwards and it is very subjective, (Ackerman and Heinzerling, 2001, Shogren and Stamland, 2001). This paper proposes life insurance policy value (LIPV) as an alternative to the VSL. The proposed LIPV is used here in a Cost Benefit analysis of a fishing emergency rescue system in Oman. The estimated benefits and costs are discounted to reflect the fact that the diffusion of the new fishing emergency rescue system, like any new technology, will not be instantaneous. In this case the adoption indices suggested by Van den Ban and Hawkins (1993) are used. Results based on a lower bound of LIPV show that the benefits of the proposed fishing emergency rescue system exceed the costs. The government is thus encouraged to provide incentives to induce fishermen to adopt the system in order to reduce the number of fatalities experienced yearly.

Keywords: value of statistical life, life insurance policy value, cost benefit analysis, fisheries.

Introduction

Society has limited resources that it can spend on public programs such as improvements in public health and safety. It is, therefore, imperative that the society should obtain the greatest benefit for each dollar spent on such programs. Determining an appropriate value, therefore, becomes necessary, and this requires not only placing a monetary value on the reduction in the risk of death by individuals for example, in the program area, but also requires estimating the costs of such programs.

As one would expect, the correct numerical value to place on a life, typically called the value of a statistical life (hereafter VSL) is a matter of great controversy (Ackerman and Heinzerling, 2001). A number of analyses using widely varying methodologies have been conducted to determine the VSL. There are basically three main approaches that have been used so far in the literature to place a monetary value on the reduction in the risk of death.

The first approach is the contingent valuation (hereafter CV) method, where survey respondents are directly asked about their willingness to pay (hereafter WTP) for mortality risk reductions. For example Smith and Gilbert (1984) estimate the value of life by examining the premium a family is willing to pay for housing in a city neighborhood with low air pollution and low risk of developing cancer. This approach, however, has been criticized because of its subjectivity. This is because all of the questions are hypothetical and as a result, it is natural to expect that the answers given by the subjects would not reflect the tradeoffs that they are willing to make. The second approach is the revealed preferences (hereafter RP) method. This approach examines the premium that individuals must be paid to take on an activity with high risk of death or injury. Data on wage premiums and the probability of death on the job are usually used to compute the implicit value that workers in dangerous jobs attach to their lives. Studies in this area include Smith (1979), Garen (1988), Biddle and Zarkin (1988), Moore and Viscusi (1988, 1990), Viscusi (1993) and Miller (1990). The RP approach has also been criticized on the ground that it is biased upwards (Shogren and Stamland, 2001). The third approach is an extrapolation method that uses VSL estimates from developed countries to derive VSL estimates for developing countries. This is because of scarcity of data on willingness to pay to avoid death and on wage-risk tradeoffs in developing countries, example of such studies include Bowland and Beghin (1998) and Alberini et al. (1997). This approach has also been criticized on grounds that it is biased and it has no strong theoretical justifications.

It is clear from the literature highlighted above that there is no widely accepted and theoretically sound approach in the estimation of the WTP to avoid or reduce the risk of death or injury. As a result of the weaknesses of the previous approaches, in this study we propose an alternative to VSL derived from CV and RP. We propose the use of life insurance policy value (hereafter LIPV). This is the value of the life insurance that individuals purchase so that their families or their estate would receive that amount in the event that the insurance policy holder is deceased. If the insurance market works efficiently we would expect the insurance payout i.e., the LIPV to reflect, more or less the true value of the life lost.

The objective of this paper is, therefore, two fold. First is to propose an alternative approach to the VSL. As highlighted above the VSL has been criticized in the literature for being subjective and difficult or impossible to apply in developing countries such as Oman. Second, is to apply this approach to a cost benefit analysis of setting-up a fishing emergency rescue system in Oman.

This paper is organized as follows. The next section gives an overview of the Oman fishing industry. Section 2 provides a discussion regarding life insurance as an alternative to the VSL. Section 3 briefly describes the proposed rescue system. Section 5 identifies the benefits and costs of the proposed rescue system. Section 5 presents the final section is the concludes the paper.

1. The Oman fishing industry

The fishing industry is one of the most important sectors of the Oman economy in terms of employment, export earnings and food security. The importance of the sector in the GDP is expected to increase as we approach year 2020 while the contribution of the oil sector is expected to decrease. Fishing in Oman is mainly undertaken by small-scale family enterprises, accounting for almost 81 percent of the fish catch. Commercial or industrial methods, account for only approximately 19 percent of the fish caught. The traditional fishing in Oman is carried out by small-scale fishing units often made up of family-related groups using small, low-powered boats fitted with outboard motors.

Safety precaution is very important in marine fishing; otherwise it can be the most dangerous of all civilian occupations. This is not a problem in Oman only – in the United States, the Bureau of Labor Statistics (2005) rank fishing as the most dangerous of all occupations.

In many developing countries such as Oman, the lack of safety equipments and inadequately enforced regulations are the main causes of fatalities. Statistics from the Oman Coast Guard shows that 371 fishermen were lost from 1998 to 2002, which is an average of 74 fishermen per year. The highest number lost in a single year was 83 in 1999 and the lowest was 65 in year 2001. These fatal sea fishing accidents occurred largely due to lack of sea safety equipment and the absence of an organized and coordinated emergency rescue system. The establishment of a well organized and coordinated fishing rescue system in Oman is long overdue. This paper is an effort to show that, based on the latest stylized cost benefit approaches it is justifiable to establish such a rescue system because the benefits outweighs the costs.

2. LIPV as an alternative to VSL

The lifecycle model has been previously used to make sense of the VSL, see for example Aldy and Viscusi (2007). The life cycle model has also been used to explain LIPV as in Yaari (1965), Gokhale and Kotlikoff (2002) and Pliska and Ye (2007). This paper seeks to establish the link between the VSL and LIPV so as to justify the use of LIPV as an alternative to VSL. Next we show how VSL is arrived at or derived using the life-cycle model and thereafter we look at LIPV and finally we show the link between the two.

2.1. VSL. In the lifecycle model an agent at the beginning of period i (i.e., at age i) maximizes the present value of the expected utility V_i over the remainder of his lifetime:

$$V_i = \sum_{t=1}^{T} P \sum_{t=1}^{T} P_{i,t} (1+\rho)^{i-t} U_t(C_t), \quad (1)$$

where V_i is equal to the present value of utility of consumption in each period, $U_t(C_t)$, times the probability that the individual survives to that period, $P_{i,t}$, discounted to the present at the subjective rate of time preference, ρ. T is the maximum length of life.

V_i is maximized subject to initial wealth, W_i, and a budget constraint that reflects opportunities for borrowing and lending. Assume that individuals can borrow and lend at the risk-less rate r, and must have non-negative wealth in all periods,

$$W_t = W_i + \sum_{m=i}^{t} (1+r)^{i-m} (Y_m - C_m) \geq 0 \quad i \leq t \leq T, \quad (2)$$

where Y_m is income at age m. The life-cycle model can be used to determine the amount of initial wealth that an individual would relinquish to reduce R_i, the probability that the individual will die during the current period. A reduction in R_i will increase the probability that the individual survives to all future periods because by definition, $P_{i,t}$ is the product of the probabilities that the individual does not die (1-R_i) in all periods from i to t-1,

$$P_{i,t} = (1-R_i)(1-R_{i+1}) \, \ldots\ldots\ldots \, (1-R_{t-1}). \quad (3)$$

The rate of substitution between R_i (the probability of death in period i) and W_i (wealth in period i) is the VSL for an individual of age i, VSL_i

$$VSL_i = \frac{\left(\partial V_i \big/ \partial R_i\right)}{\left(\partial V_i \big/ \partial W_i\right)} = \frac{\partial W_i}{\partial R_i}. \tag{4}$$

Based on equation (4) and on Aldy and Viscusi (2007) it is straightforward to show that the *VSL* is a function of:

$$VSL_i = f(IPC, IJC, OFR), \tag{5}$$

where *IPC* is a vector of an individual's personal characteristics; *IJC* is a vector of an individual's job characteristics; *OFR* is the occupational fatality risk for this individual.

The individual's personal characteristics typically include measures of human capital, such as education and experience, individual's level of wealth, family obligations (e.g., family size/number of children) and other factors, such as union status. The individual's job characteristics often include indicators for the nature of the job, that is, whether the job is blue-collar, white-collar, management, etc. The occupational mortality risk variable reflects the exposure to risk and this is assumed to vary with age. Next we look at LIPV.

2.2. Life insurance policy value. Perhaps it is important first to define life insurance. Life insurance is a contract between the policy owner and the insurer, whereby the insurer agrees to pay a sum of money upon the occurrence of the policy owner's death. In return, the policy owner agrees to pay a stipulated amount called a premium at regular intervals. In essence, life insurance policies are financial products that offer income replacement for premature death and can also be a long-term savings instrument, Beck and Webb (2002).

There are a host of different types of policies, each offering the consumer different options with regard to coverage and investment choice. Overall however, they can be grouped into two general categories: those offering mortality coverage only, also known as "term" policies; and, those combining mortality coverage with a savings component and known as whole life. This second type or "whole life" policy, typically earn interest, which is returned to the consumer through policy dividends, cash-values on termination of the policy, or endowment sums on maturation of the policy. For simplicity we focus on "term" policies – that is policies that offer mortality coverage only.

The first people to develop a theoretical framework to explain the demand and hence the value of life insurance ("term" policies) were Yaari (1965) and Hakansson (1969). In their framework, consumer maximizes lifetime utility subject to a vector of interest rates and a vector of prices including insurance premium rates. This framework hypothesizes the demand for "term" life insurance to be a function of wealth, expected income over an individual's lifetime, the level of interest rates, the administrative cost of life insurance policies, and the assumed subjective discount rate for current over future consumption, which is basically the lifecycle model in equations (1) and (2). Lewis (1989) extended the Yaari and Hakansson framework to incorporate preferences of the dependents and beneficiaries into the model. In particular, Lewis (1989) explains the demand for insurance as a maximization problem of the beneficiaries, in this case the spouse and the children of the policyholder. Gokhale and Kotlikoff (2002) show that the adequacy of life insurance is determined by: age, life expectancy and the health condition of the policy holder and his or her spouse, income which is a function of the individual's job characteristics, family size and the level of wealth. Pliska and Ye (2007) show that optimal life insurance is a function of individual's current wealth; income; hazard rate and the attitude towards risk, in other words the degree of risk aversion.

Based on the literature above we can conclude that an individual *i*'s life insurance policy value ($LIPV_i$) is a function of:

$$LIPV_i = f(IPC, IJC, ICW, HR, DRA), \tag{6}$$

where *IPC* is a vector of an individual's personal characteristics; *IJC* is a vector of an individual's job characteristics; *ICW* is the individual's current wealth; *HR* is the Hazard rate; *DRA* is an Individual's degree of risk aversion or the attitude towards risk.

In theory, equations (5) and (6) on average should lead to more or less the same value. However, because of the subjective nature of questions asked to solicit information needed to estimate *VSL* in equation (5), in practice, individuals tend to overestimate the compensation they require to undertake risk and hence leading to the problems and criticisms associated with the *VSL*. On the other hand, in equation (6) individuals are less likely to inflate their *LIPV* because *LIPV* determines the premium that the individual will have to pay for the policy and furthermore, *LIPV* is arrived at through the interaction between the insurance agent and the policy holder guided by some formula.

In practice obtaining *LIPV* data is straightforward because this information is readily available from many sources, even in developing countries.

For the purpose of this paper we assume that the insurance market in Oman is functioning properly, such that *LIPV* can be used as an alternative to *VSL* in the cost benefit analysis to estimate the benefits of a Fishing Safety Telecommunication System in Oman. For simplicity however in our numerical example we use the Comprehensive car insurance payout in case of death which is a lower bound of *LIPV*. The comprehensive car insurance payout in case of death is the amount paid across the board when a person dies in a car accident regardless of his or her individual characteristics indicated in equations (5) and (6). It is a lower bound because a typical *LIPV* will not fall below this lower bound.

3. The proposed rescue system

There are many ways that the proposed fishing safety and rescue system could be organized, one possibility is as follows. Each fisherman or a fishing team will be equipped with one satellite cellular phone such as the "*Thuraya*" system that is widely available in the region.

The currently used hotline 999 of the Royal Omani Police (hereafter ROP) should be used by fishermen to connect to the Coast Guard directly. The ROP Coast Guard will respond to such a call by dispatching a helicopter or a fast rescue boat. The satellite phone allows the ROP Coast Guard to determine the exact GPS location of the fishermen who will then be located easily and quickly. The satellite phone calls are much more expensive than the local GSM providers. Thus a satellite connection should be used only in case of emergency. This is possible nowadays because of the availability in the market of hand phone sets that can be fitted with two SIM cards simultaneously. So the fishermen need not to change the SIM card every time they go fishing. The other innovation in the market is that all hand set mobile phones can became water proof by using a thin protector called "skin", which avoids the need to buy a water proof mobile phone.

4. Identifying benefits and costs of the proposed rescue system

Benefit cost analysis is recommended as the technique to use in a formal economic analysis of government programs or projects, such as this one. The standard criterion for deciding whether a government program can be justified on economic grounds is net present value (*NPV*), which is the discounted monetized value of expected net benefits (i.e., benefits minus costs).

NPV is computed by assigning monetary values to benefits and costs, discounting future benefits and costs using an appropriate discount rate, and subtracting the sum of discounted costs from the sum of discounted benefits. Discounting benefits and costs transforms gains and losses occurring in different time periods to a common unit of measurement. Programs with positive *NPV* increase social resources and are generally preferred, while programs with negative *NPV* are generally rejected.

Identifying benefits and costs is a very difficult task, simply because some of the benefits and costs are tangible and others are intangible and hence difficult to identify. The proposed rescue system will be based on a new technology (the "*Thuraya*" system), we therefore expect the adoption of the proposed system (by fishermen in Oman) to follow the adoption indices suggested by Van den Ban and Hawkins (1993). As a result, benefits and costs are discounted to reflect the fact that the diffusion of the new rescue system, like any new technology, will not be instantaneous. In this case the following adoption indices: 2.5%, 13.5%, 34.0%, 34.0%, and 16.0% respectively have been used to discount benefits and costs for the first five years of the proposed system.

In order to compute net present value, it is necessary to discount future benefits and costs. This discounting reflects the time value of money. Benefits and costs are worth more if they are experienced sooner. All future benefits and costs should be discounted. The real rate of interest of 5% has been used to discount future benefits and costs; this rate of interest has been used in other studies such as Viscusi (1995). The present value of a stream of benefits and costs is given by:

$$PV_0 = \frac{Y_1}{(1+r)^1} + \frac{Y_2}{(1+r)^2} + \frac{Y_3}{(1+r)^3} + ... + \frac{Y_{25}}{(1+r)^{25}} = \tag{5}$$
$$= Y_1(PIF_{r,1}) + Y_2(PIF_{r,2}) + Y_3(PIF_{r,3}) + ... + Y_{25}(PIF_{r,25}),$$

where Y_1 represents the benefits and or costs incurred in year 1; Y_2 represents the benefits and or costs incurred in year 2, and so on, the higher the discount rate, the lower is the present value of future cash flows. *PIF* is the present interest factor which is just equal to $1/(1+r)^n$. For typical investments, with costs concentrated in early periods and benefits following in later periods, raising the discount rate tends to reduce the net present value

4.1. Identifying benefits. As stated in the introductory section Oman has a total of 30,421 fishermen. On average 74 fishermen die each year. The average age of fishermen in Oman, based on a recent survey of 210 fishermen is 40 years and the retirement age is assumed to be 65 years. Implying that on average a fisherman in Oman has a total of 25 years of active fishing career. In case of death comprehensive car insurance[1] pays Rial Oman (RO) 7,000 per per-

[1] It is important to mention here that the comprehensive car insurance numbers may not be a good proxy for LIPV. However the comprehensive car insurance numbers were used here just to provide a numerical example or a lower bound for LIPV.

son, which is a total of US$18,270 at the current exchange rate of 1 RO = 2.61 US dollars, representing the lower bound of *LIPV* in equation (6). The US$18,270 translates to US$1,351 million per year for the 74 lives that are likely to be saved once the rescue system is in place. Assuming the adoption indices suggested by Van den Ban and Hawkins (1993), the benefits are discounted to reflect the fact that the diffusion of the new rescue system, like any new technology, will not be instantaneous. In this case during the first four (4) years the benefits are discounted using the following cumulative indices: 0.025, 0.16, 0.5, 0.84, and 1.0 for the fifth year. Meaning that full adoption is likely to be achieved during the fifth year and it is from the fifth year onwards that the US$1,351 million will be fully realized (see Table 1 in Appendix).

4.2. Identifying costs. The anticipated costs of the proposed fishing safety telecommunication system are somewhat difficult to identify and quantify. We take the budget of the Defense and National Security[1] as published in the Central Bank of Oman 2004 annual report for the period 2000 to 2004 and obtain an average annual figure for that period. Because the search and rescue activity is a very small and insignificant additional responsibility for the coast guard, we assume that this additional task only requires 0.02 percent of the average budget of the Defense and National Security. The costs are also discounted in the same way the benefits were discounted using the adoption indices suggested by Van den Ban and Hawkins (1993), see Table 1.

5. Results and discussion

The benefits[2] and costs of the proposed system are as reported in Table 1. These benefits and costs are discounted using risk-less discount rate to obtain the discounted net presentv of benefits and costs. The resulting net present value is around US $ 3.54 million, implying that the benefits of the proposed rescue system exceed the costs. Table 2 (in Appendix) reports the discounted benefits of the rescue system at 77 percent success rate leaving the cost of the system constant. The resulting net present value is negative $1,223.81. At 78 percent success rate, the net present value is $152,756.44. These results show that the rescue system will be viable even at 78 percent success rate. Given on average 74 perish each year this means that the costs of the system will be justifiable if a minimum of 56 (78% of 74) fishermen will be rescued on average per year.

A sensitivity analysis was conducted by uniformly inflating costs by 10% while leaving the estimated benefits at their original levels. The result of the sensitivity analysis is a net present value of approximately US$2,354 million (results are available from the authors). These results seem to suggest that the proposed system is justifiable economically because the benefits of setting up such a system significantly exceed the costs in addition to the net intangible benefits of avoiding death accidents to family heads.

Conclusions

The objectives of this paper are, first to propose an alternative approach to the VSL which has been criticized in the literature for being subjective and difficult to apply in a developing country setting. Second, it is to undertake a cost-benefit analysis of setting-up a fishing emergency rescue system in Oman employing the alternative approach to VSL approach. The alternative approach is simply to use the LIPV, the equivalence of VSL and LIPV has been established (Re: equations (5) and (6)) using the life cycle model). It is simple and easy in any setting to put together data on LIPV as compared to the VSL approach that is based on either Contingent Valuation (CV) or the Revealed Preference (RP).

Regarding the second objective, a cost benefit analysis has been carried out and the resulting net present value (NPV) is positive. A positive NPV implies that the benefits of the proposed rescue system exceeds the costs, as a result, such a system is justifiable on economic and social grounds.

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[1] The Royal Oman Police Coast Guard falls under Defense and National Security.

[2] Assuming 100 percent success rate of the rescue system, a number of marine Search and Rescue Systems reviewed reported a success rate of 96.2 to 98.6 percent e.g., the Australian Maritime Safety Authority(AMSA) available at: http://www.amsa.gov.au/About_AMSA/Corporate_information/Annual_reports/2007-2008/annual_report07-08.pdf

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Appendix

Table 1. The discounted benefits and costs of a fishing rescue system in Oman

Year	Benefits	Costs	Discount rate	Discounted benefits	Discounted costs
1	$33,799.50	$211,162.57	0.952	$32,177.12	$201,026.77
2	$216,316.80	$1,140,277.89	0.907	$196,199.34	$1,034,232.05
3	$675,990.00	$2,871,810.98	0.864	$584,055.36	$2,481,244.69
4	$1,135,663.20	$2,871,810.98	0.823	$934,650.81	$2,363,500.44
5	$1,351,980.00	$1,351,440.46	0.784	$1,059,952.32	$1,059,529.32
6	$1,351,980.00	$506,621.88	0.746	$1,008,577.08	$377,939.92
7	$1,351,980.00	$506,621.88	0.711	$961,257.78	$360,208.16
8	$1,351,980.00	$506,621.88	0.677	$915,290.46	$342,983.01
9	$1,351,980.00	$506,621.88	0.645	$872,027.10	$326,771.11
10	$1,351,980.00	$506,621.88	0.614	$830,115.72	$311,065.83
11	$1,351,980.00	$506,621.88	0.585	$790,908.30	$296,373.80
12	$1,351,980.00	$506,621.88	0.557	$753,052.86	$282,188.39
13	$1,351,980.00	$506,621.88	0.53	$716,549.40	$268,509.60
14	$1,351,980.00	$506,621.88	0.505	$682,749.90	$255,844.05
15	$1,351,980.00	$506,621.88	0.481	$650,302.38	$243,685.12
16	$1,351,980.00	$506,621.88	0.458	$619,206.84	$232,032.82
17	$1,351,980.00	$506,621.88	0.436	$589,463.28	$220,887.14
18	$1,351,980.00	$506,621.88	0.416	$562,423.68	$210,754.70
19	$1,351,980.00	$506,621.88	0.396	$535,384.08	$200,622.26
20	$1,351,980.00	$506,621.88	0.377	$509,696.46	$190,996.45
21	$1,351,980.00	$506,621.88	0.31	$419,113.80	$157,052.78
22	$1,351,980.00	$506,621.88	0.255	$344,754.90	$129,188.58
23	$1,351,980.00	$506,621.88	0.231	$312,307.38	$117,029.65
24	$1,351,980.00	$506,621.88	0.21	$283,915.80	$106,390.59
25	$1,351,980.00	$506,621.88	0.173	$233,892.54	$87,645.59
Present value of benefits and costs				$15,398,024.70	$11,857,702.83
Net present value				$3,540,321.87	

Table 2. The discounted benefits and costs of a fishing rescue system in Oman (assuming 77 percent success rate)

Year	Benefits	Costs	Discount rate	Discounted benefits	Discounted costs
1	$26,025.62	$211,162.57	0.952	$24,776.39	$201,026.77
2	$166,563.94	$1,140,277.89	0.907	$151,073.49	$1,034,232.05
3	$520,512.30	$2,871,810.98	0.864	$449,722.63	$2,481,244.69
4	$874,460.66	$2,871,810.98	0.823	$719,681.13	$2,363,500.44
5	$1,041,024.60	$1,351,440.46	0.784	$816,163.29	$1,059,529.32
6	$1,041,024.60	$506,621.88	0.746	$776,604.35	$377,939.92
7	$1,041,024.60	$506,621.88	0.711	$740,168.49	$360,208.16
8	$1,041,024.60	$506,621.88	0.677	$704,773.65	$342,983.01
9	$1,041,024.60	$506,621.88	0.645	$671,460.87	$326,771.11
10	$1,041,024.60	$506,621.88	0.614	$639,189.10	$311,065.83
11	$1,041,024.60	$506,621.88	0.585	$608,999.39	$296,373.80
12	$1,041,024.60	$506,621.88	0.557	$579,850.70	$282,188.39
13	$1,041,024.60	$506,621.88	0.53	$551,743.04	$268,509.60
14	$1,041,024.60	$506,621.88	0.505	$525,717.42	$255,844.05
15	$1,041,024.60	$506,621.88	0.481	$500,732.83	$243,685.12
16	$1,041,024.60	$506,621.88	0.458	$476,789.27	$232,032.82
17	$1,041,024.60	$506,621.88	0.436	$453,886.73	$220,887.14
18	$1,041,024.60	$506,621.88	0.416	$433,066.23	$210,754.70
19	$1,041,024.60	$506,621.88	0.396	$412,245.74	$200,622.26
20	$1,041,024.60	$506,621.88	0.377	$392,466.27	$190,996.45
21	$1,041,024.60	$506,621.88	0.31	$322,717.63	$157,052.78
22	$1,041,024.60	$506,621.88	0.255	$265,461.27	$129,188.58
23	$1,041,024.60	$506,621.88	0.231	$240,476.68	$117,029.65
24	$1,041,024.60	$506,621.88	0.21	$218,615.17	$106,390.59
25	$1,041,024.60	$506,621.88	0.173	$180,097.26	$87,645.59
Present value of benefits and costs				$11,856,479.02	$11,857,702.83
Net present value				$1,223.81	

Table 3. The discounted benefits and costs of a fishing rescue system in Oman (assuming 78 percent success rate)

Year	Benefits	Costs	Discount rate	Discounted benefits	Discounted costs
1	$26,363.61	$211,162.57	0.952	$25,098.16	$201,026.77
2	$168,727.10	$1,140,277.89	0.907	$153,035.48	$1,034,232.05
3	$527,272.20	$2,871,810.98	0.864	$455,563.18	$2,481,244.69
4	$885,817.30	$2,871,810.98	0.823	$729,027.63	$2,363,500.44
5	$1,054,544.40	$1,351,440.46	0.784	$826,762.81	$1,059,529.32
6	$1,054,544.40	$506,621.88	0.746	$786,690.12	$377,939.92
7	$1,054,544.40	$506,621.88	0.711	$749,781.07	$360,208.16
8	$1,054,544.40	$506,621.88	0.677	$713,926.56	$342,983.01
9	$1,054,544.40	$506,621.88	0.645	$680,181.14	$326,771.11
10	$1,054,544.40	$506,621.88	0.614	$647,490.26	$311,065.83
11	$1,054,544.40	$506,621.88	0.585	$616,908.47	$296,373.80
12	$1,054,544.40	$506,621.88	0.557	$587,381.23	$282,188.39
13	$1,054,544.40	$506,621.88	0.530	$558,908.53	$268,509.60
14	$1,054,544.40	$506,621.88	0.505	$532,544.92	$255,844.05
15	$1,054,544.40	$506,621.88	0.481	$507,235.86	$243,685.12
16	$1,054,544.40	$506,621.88	0.458	$482,981.34	$232,032.82
17	$1,054,544.40	$506,621.88	0.436	$459,781.36	$220,887.14
18	$1,054,544.40	$506,621.88	0.416	$438,690.47	$210,754.70
19	$1,054,544.40	$506,621.88	0.396	$417,599.58	$200,622.26
20	$1,054,544.40	$506,621.88	0.377	$397,563.24	$190,996.45
21	$1,054,544.40	$506,621.88	0.310	$326,908.76	$157,052.78
22	$1,054,544.40	$506,621.88	0.255	$268,908.82	$129,188.58
23	$1,054,544.40	$506,621.88	0.231	$243,599.76	$117,029.65

Table 3 (cont.). The discounted benefits and costs of a fishing rescue system in Oman (assuming 78 percent success rate)

Year	Benefits	Costs	Discount rate	Discounted benefits	Discounted costs
24	$1,054,544.40	$506,621.88	0.210	$221,454.32	$106,390.59
25	$1,054,544.40	$506,621.88	0.173	$182,436.18	$87,645.59
Present value of benefits and costs				$12,010,459.26	$11,857,702.83
Net present value				$152,756.44	