EUROPEAN ACADEMIC RESEARCH
Vol. III, Issue 2/ May 2015

ISSN 2286-4822
www.euacademic.org

Impact Factor: 3.4546 (UIF)
DRJI Value: 5.9 (B+)

An Economic Analysis of Duqm Fishery Harbor in Oman

Dr. DIPTI RANJAN MOHAPATRA
Associate Professor (Economics)
School of Business and Economics
Madawalabu University
Bale Robe, Ethiopia

Abstract:

Sultanate of Oman has recently taken up a project to establish an integrated fishery harbor in south of Sea port in Duqm in order to full fill Country's Long Term National Development Strategy (1996 – 2020) for economic diversification and food security strategy. This green field development project is expected to attract huge investments in modern fishing and fishery-related activities. It is also expected to generate large employment, as well as will enhance the contribution of the fishery sector to the Gross Domestic Product of the country. Here, an attempt has been made to find out the economic viability of construction of such Fishery Harbour in Duqm site in Oman. The economic benefits are calibrated by carrying out a cost-benefit analysis. A net cash flow technique has been adopted. The proposed project found to be economically viable with a project IRR of 15.62%. The NPV @12% is estimated 8.8 million Omani Rial. The robustness of the project is further proved by carrying out a sensitivity analysis. Overall the proposed investment programmes is found to be economically viable.

Key words: Economic Internal Rate of Return (EIRR), economic viability, discounted cash flow, OLS

JEL Classification: G13, G31, H43, R33

1.0 Introduction

The fish resources of Arabian Sea are favorites all over the World especially in Middle East and Europe. Duqm is a port town in central-east of Oman on the coast of Arabian Sea widely known for its fishing settlement. The location of Duqm is shown in map below in Figure 1. The famous fish varieties and crustaceans' species are abundantly available in Duqm coast because of its proximity to Indian Ocean and Arabian Sea. Thus, Omani government has recently taken up a project to establish an *integrated fishery harbor* in south of Sea port in Duqm in Special Economic Zone in order to exploit the advantage of its traditional affinity to fishing verities. The fishery hub is spread over an area of 8 square kilometer and is an attempt in achieving sustainable growth of fisheries sector in the Sultanate. The Duqm Special Economic Zone Authority (SEZAD) looks after the overall economic activities in Duqm, including infrastructural development and investment. The integrated fishing harbor project will be constructed at (-) 6 meter depth with facilities to to accommodate small and medium size fishing boats, providing enough land to house fish processing, canning, fish oil and animal feed industries, creating facility for fish and shrimp farming, establishment of an international standard quality assurance center for fresh and processed fish exports, setting up a marine research center and a training extension service center and building up retail, wholesale & export markets. In Phase 2 of the zone's development, aquaculture-related projects are proposed to be integrated into the scheme, alongside plans for fishmeal and oil plants, electronic trading platforms, and an enhanced cluster of fish processing units. In effect, the Fishery Zone has been conceived as a national hub for the capture, processing, farming and distribution of fish. A 24-month timeframe (27 months with the alternative option) has been stipulated for the execution of the fish harbor project. As a green-field development, the Duqm

Fishery Harbour will feature all of the trappings of a full-fledged fishing port, complete with breakwaters, dredged basin and access channel, jetty, pontoons, and so on. This project has been designed to maximize economic returns to Omanis engaged in the country's fisheries sector, strengthen food security, generate jobs for nationals, and facilitate the introduction of technology and innovation in the industry. It is also a part of Country's economic diversification and food security strategy along the line of Long Term National Development Strategy (1996 – 2020) of Oman. The Ministry of Agriculture and Fisheries of Sultanate, is overseeing the implementation of the Duqm facility. When operational, tentatively during 2016, the harbor will help harness the potentially vast marine resources of the Wusta coast. It is also expected to attract investments in modern fishing fleets, fish processing plants, aquaculture projects, and other fishery-related activities, thereby helping generate employment on a significant scale, as well as enhance the contribution of the fisheries sector to the Gross Domestic Product.

Figure 1: Location of Duqm in Oman

2.0 Objective

In this paper; we have attempted to find out the economic viability of the fishing harbor development project in Duqm, Oman. A cost-benefit approach has been adopted here to carry out the Economic Internal Rate of Return (EIRR).

3.0 Review of Literature:

In developing countries, infrastructure development projects are usually undertaken by public, particularly on account of its strategic importance to the economy, and the large investment cost as well as long pay-back periods (Lim, 2002).

The marketing strategy that helps in optimizing the potential of a port as there is a correlation between generation of new demand and the potential. All these come under the umbrella of economic functions of a port. Understanding the economics of a port project is vital before chalking the plans to implement it in a mega way. The role of port has undergone many changes and its importance has increased multiple due to increase n globalization, technological progress and competition. This transition could be well defined in terms of interchange industrialization. In any port project economies of scale are vital as it ensure reduced cost (Muso, 2004). Economies scale comes along with bulk transaction and handling in case of a port. There is also shift in trends in choosing port in these days. Earlier, port taxes and handling tariff were important criteria which have shifted to service reliability, service time to ship and freight. This is something related with functional change in the traditional service role of the port to value added services (Theodoros, et. al., 2004).

Now ports have become vital in maintaining the sustainability of an economy as they are now a big industry. This has changed the traditional role ports from part of an industry to industry. The traditional role port has also changed

from transitional point to value added logistic and distribution center which is synonymous with corporate authority and corporate culture. The output of any port is now considered from the point of view of its success in establishing the tradeoff between the economies of scale to economy of scope. This ensures the role of any port in generating additional employment in service industry as well as increasing the GDP of any economy. Similarly the factor of change is observed from point of view of technological knowhow to information sharing. Thus the importance of information technology services is very vital and paramount in any port project (UNESCAP, 2002).

There are certain special features of infrastructure investment. Infrastructure projects have long economic life, require huge capital during construction period; the amount of investment capital is irreversible, long construction periods, fixed costs are higher than variable costs, higher amount of public debt, zero returns during construction, long payback period and high degree of risks and uncertainty (ECMT, 1990 and Wiegmans, 2002). Thus, huge amount of capital investment makes the mega port project unattractive for private sector investment. Therefore the public investment in such project has to be carefully chosen by taking into account the cost and benefits for certain period. This is also true for any port project including construction fishery harbor project in Duqm, Oman.

The economic impact of smart investment in infrastructure creates millions of jobs. These jobs are created across a wide variety of different industries. This was confirmed by Haugwout (2002) in his study on productivity and welfare aspects of public infrastructure investments.

Cost-Benefit analysis is a methodology the objective of which is to make a balance between costs and benefits ensuring minimum costs and optimum (maximum) output. The project is recognized when it utilizes the social benefits to the economy in terms of economic internal rate of return and commercial viability in terms of financial rate of returns (Jones et.al. 2000).

4.0 Methodology and Approach

Economic viability of the fishing harbor development project in Duqm, Oman has been assessed within the broad framework of "Cost-Benefit Analysis", generally used for appraisal of public investment projects. The main objective of the analysis is to identify the project benefits and to compare them with project costs over the economic life of the project so as to justify its implementation. In case of financial analysis, the profits accruing to an individual entity making investment become the major factor for evaluation, whereas in economic analysis the benefits to the economy are the main criteria for evaluation. Accordingly, the costs to be considered in economic analysis are different than those in financial analysis. In financial analysis, total cost of project at market prices is considered. However, for economic analysis, financial costs are converted into economic costs, which are the net of taxes, duties and royalties.

The economic analysis involves comparison of project costs and benefits in economic terms and determining the Economic Internal Rate of Return (EIRR) of the project using Discounted Cash Flow (DCF) technique. This shows the return, which the society could expect from the proposed investment during the project life, i.e. analysis period of 22 years, 2 years construction period and 20 years of benefit period. The EIRR is then compared with the accounting rate of return of 12 percent considered as the cut-off point for investment decision by the Government of India and international funding agencies like the World Bank (WB) and the Asian Development Bank (ADB) or African Development Bank.

The main steps followed are:

i) Estimation of capital and maintenance costs (both regular and periodic) at economic prices, along with the capital cost phasing

ii) Estimation of economic benefits

iii) Comparison of annual streams of costs with benefits and estimation of EIRR on the basis of DCF technique.

The project is further subjected to sensitivity analysis by assessing the effects of adverse changes in the key variables on the base EIRR. This helps to gauge the economic strength of the project to withstand future risks and uncertainties.

5.0 Project Cost and Scheduling

The project cost consists of two main components:

- Capital cost
- Maintenance cost

Economic analysis requires the conversion of financial costs into economic costs to take care of distortions in prices due to market imperfections. Taxes and duties are removed from financial prices as these are not real costs to the economy, but are only transfer payments. All financial costs have been converted into economic costs, which are net of taxes and duties, generally a factor of 0.85, as recommended by the World Bank or Asian Development Bank in the latest Guidelines for economic evaluation of infrastructure projects to convert financial cost into economic cost. The same conversion factor is used for the present analysis.

6.0 Cost and Its Phasing

6.1 Capital Cost: The capital cost of the project is spread over first eight years of the analysis period and estimated as RO 37.35 million {1 Omani Rial (OMR or RO) = 2.59875 USD}.

The economic cost of the project is worked out by applying the conversion factor of 0.85 to all financial costs. The

phasing of the capital cost of the project both in financial and economic terms, are presented in the table below:

Table 1: Capital Cost of the Project *(In OMR)*

Classification	***Estimated Cost (RO)***	***RO Million***
Total cost (including 5%) Contingency – Financial Cost	3,73,53,365	37.35
Economic Cost	3,17,50,360	31.75
Phasing of Cost (Economic Cost)		
Period	*Share of Total Cost*	*Investment in Million RO*
First 12 Months	60%	19.05
Rest 6 Months	40%	12.70
Total	*100%*	*31.75*

6.2 Maintenance Cost: The maintenance cost of the project is considered as 2% of the project cost. The maintenance cost is also converted to economic cost applying a conversion factor of 0.85.

7.0 Projection of Landing of Fish

In the absence of disaggregated time series data the projection of fish landing is done for the country as a whole. Subsequently the projected figures are apportioned to the specific fishing regions. The methodology that has been adopted for the projection purpose is presented in the following section.

7.1 Methodology for Projection of Fish Landing: The quantum of landed fish, as observed from the published data, has its own trend. Through there is high level of variation in the year to year, overall there is a increasing trend over a period of ten years from 1999 to 2008. The quantum of landed fish and the trend thereby is a reflection of optimum utilization of infrastructure, technology and marine resources.

Generally all projection process takes into account the explanatory variables that explain the future value of the study variables. However, in case of fish landing, the most important aspect is the uncertainty. Uncertainty is that portion of the

predicted value that remained unexplained in the model. In the present forecasting technique a OLS is established and a special treatment is applied to handle the uncertainty. The OLS is performed with a time dummy and the P value shows significant (using SAZAM).

In the process of handling uncertainty an estimate of stochastic central deterministic output indicators using triangular point value based on Bayesian probability distribution functions is used.

Point values of the probability distribution are adopted based on the limits of the last five years trend:

Thus in the normal distribution the estimated point values are:

Point values X *max* {0.972}
X *mid* {1.000}
X *min* {1.036}

7.2 Projected Quantity of Fish Landing: The quantum of fish landed over the last ten years in Oman is presented in the following Table 2 and Figure 2 & 3. The table also shows the share of export in the total landing of fish.

Table 2: Past Landing of Fish in Oman and Share of Export

Year	*Landing (Ton)*	*Export (Ton)*	*Export as share of Landing (%)*
1999	96,664	45,299	46.86
2000	108,019	46,160	42.73
2001	125,275	52,464	41.88
2002	115,308	62,250	53.99
2003	118,877	69,009	58.05
2004	139,236	85,055	61.09
2005	132,612	83,476	62.95
2006	130,621	75,953	58.15
2007	135,644	74,535	54.95
2008	133,921	74,202	55.41

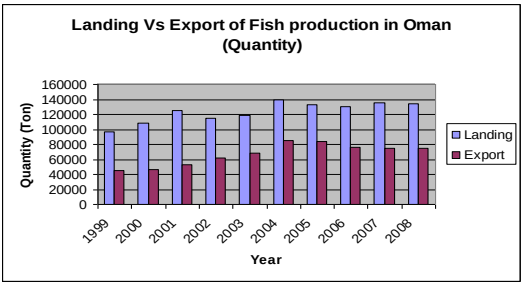

Figure 2: Landing vis-à-vis Export of Fish

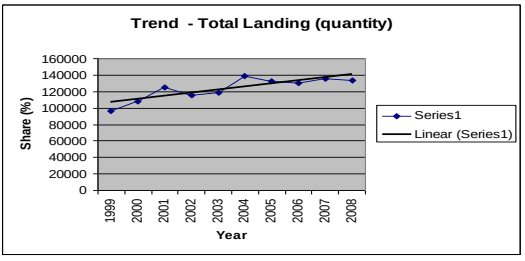

Figure 3: Total Landing (Quantity)

As stated in the methodology, the projection consists of two parts:

1) A general trend through fitting OLS

2) The general trend further adjusted for uncertainty using stochastic central deterministic output indicators. The uncertainty values are adopted after several boot strapping.

The projected fish landing for the next 20 years is presented in the following Table 3.

Table 3: Projected Landing of Fish in Oman
(Without Project)

Year	*OLS Predicted Base (Ton)*	*Uncertainty Factor*	*Uncertainty Adjusted Projected Value (Ton)*
2009	135,857	0.9782	132,902
2010	137,820	0.9943	137,028
2011	139,812	0.9949	139,099
2012	141,833	0.9783	138,760
2013	143,883	0.9983	143,637
2014	145,963	0.9852	143,801

Year	*OLS Predicted Base (Ton)*	*Uncertainty Factor*	*Uncertainty Adjusted Projected Value (Ton)*
2015	148,073	0.9808	145,231
2016	150,213	1.0213	153,407
2017	152,384	1.0076	153,549
2018	154,587	0.9973	154,172
2019	156,821	1.0132	158,891
2020	159,088	1.0147	161,429
2021	161,387	1.0328	166,676
2022	163,720	1.0270	168,145
2023	166,086	0.9974	165,656
2024	168,487	1.0141	170,860
2025	170,922	1.0059	171,929
2026	173,393	0.9886	171,416
2027	175,899	0.9930	174,672
2028	178,441	1.0150	181,113
2029	181,020	0.9984	180,738
2030	183,637	0.9808	180,113

The above table shows the both the general OLS projected as well as uncertainty adjusted fish landing in the country. According to the 2008 fish landing report, Duqm region accounts 4.47% of the total landing in the country. It may be safely assumed that the same share will prevail in the total landing as most of the landing sites are developing in the country. The following Table 4 Shows the projected landing in the Duqm site. Henceforth we will refer to the uncertainty adjusted projected landings.

Table 4: Projected Landing of Fish
In Duqm Site

Year	*Landing (in Ton)*
2009	5,940
2010	6,125
2011	6,217
2012	6,202
2013	6,420
2014	6,428
2015	6,492

Year	*Landing (in Ton)*
2016	6,857
2017	6,863
2018	6,891
2019	7,102
2020	7,216
2021	7,450
2022	7,516
2023	7,404
2024	7,637
2025	7,685
2026	7,662
2027	7,808
2028	8,095
2029	8,079
2030	8,051

8.0 Trend in Price of Fish Production

Average price of fish in the Oman market is showing an increasing trend. This is in tune with the prices in the international market. According to the average prices during the period 2005 to 2008, the average increase in the prices is 6.5% per annum.

Table 5: Trend in the Average Prices of Fish in Oman

Year	*Landing (Ton)*	*Value (In RO)*	*Value/Ton (In RO)*	*Increase in Price (%)*
2005	21,354	1,05,11,000	492.23	-
2006	18,478	92,88,000	502.65	2.12
2007	20,274	1,06,87,000	527.13	4.87
2008	20,809	1,23,34,000	592.72	12.44

The landing of fish of in the Duqm region is converted in the value term. It is considered that on the price of fish will increase at an average rate of 6% per annum. The projected value of landed fish is presented in the following Table 6.

Table 6: Value of Landed Fish in Duqm Region (Without Project)

Year	*Landing (In Ton)*	*Projected Price (Per Ton)*	*Value (In Million RO)*
2009	5,940	661.3	3.93
2010	6,125	700.9	4.29
2011	6,217	743.0	4.62
2012	6,202	787.6	4.88
2013	6,420	834.8	5.36
2014	6,428	884.9	5.69
2015	6,492	938.0	6.09
2016	6,857	994.3	6.82
2017	6,863	1,053.9	7.23
2018	6,891	1,117.2	7.70
2019	7,102	1,184.2	8.41
2020	7,216	1,255.3	9.06
2021	7,450	1,330.6	9.91
2022	7,516	1,410.4	10.60
2023	7,404	1,495.0	11.07
2024	7,637	1,584.7	12.10
2025	7,685	1,679.8	12.91
2026	7,662	1,780.6	13.64
2027	7,808	1,887.5	14.74
2028	8,095	2,000.7	16.20
2029	8,079	2,120.8	17.13
2030	8,051	2,248.0	18.10

9.0 Cost of Fishing

The average cost of fishing in the country is around 80% of the sales price. The rest 20% is the profit margin. This cost is inclusive of both tangible and intangible costs of fishing.

10.0 Project Benefits

The benefits that the project can reach are quantified based on the proposed facility development and their impact thereof. Initially field survey carried out that included interaction with

the beneficiaries. Eventually a content analysis is carried out to substantiate the different dimensions of the project benefits.

10.1 Content Analysis: A content analysis has been carried out to gauge the possible benefits that the project can bring. The findings of this analysis are fundamentally to substantiate the finding of the field survey. The content analysis principally carried out from the published news[1] on the context.

- According to Ministry's five-year plan (2011-15) several new projects are proposed to be executed. This is in addition to providing training programmes for fishermen on how to handle fish right from the water to the landing.
- Ministry has put higher importance on the activities that are focused on sea food preservation in a safe and hygienic way. Traditional fishermen fail to take precautions to keep the fish fresh because the boats that fishermen use are not spacious enough to carry ice boxes. Sometimes they don't carry enough ice thinking that if they do so they will end up carrying less fish. They need to think of quality rather than quantity
- There is lack of knowledge of using the ice to preserve fish stocks in the best way and the usage of cool boxes in this regard.
- Food- borne illnesses are the result of lack of proper hygiene. If low quality fish are consumed then there is high risk of diseases. But people in Oman are not aware of that fact. They think the fish is fresher when it is not in the ice

10.2 Benefits: There are a number of benefits that could be achieved through the project. These benefits are as follows:

[1] Speaking to *Muscat Daily*, Eng Nashwa Ali al Mazrooei, Director of Fishery Quality Control Centre; Redha Said al Faraj, Head of Sea Food Safety Implementation System Section, Directorate General of Fisheries Research.

A wide range of benefits can be generated from fisheries harbor infrastructure development, both quantifiable and non-quantifiable. The quantifiable benefits of the project are as follows:

10.2.1 Additional fish landings

Additional fish landing is expected due to reduction in the dead time and usage of modern fishing boats/ vessels. Due to improved facilities, the technology of fishing is expected to shift gradually from traditional to modern substantially. This will also improve the intensity and selectivity in the fishing activities. It is considered that that with the improved facilities the additional landing of fish will be 20% of landing without the project.

10.2.2 Reduction in operation and maintenance costs

The project facility is expected to reduce the maintenance cost of the fishing gears, equipments and the operating expenses. It is expected that due reduction in the operation and maintenance cost will be a benefit in the tune of 10% of the existing production. This will in turn increase the profit margin substantially to around 30% of the total revenue.

10.2.3 Improvement in the quality of fish

With the improved infrastructure the quality of fish will improved with proper freezing and hygiene considerations. It is considered that the improved quality will add value to the export earnings as well as to the domestic consumptions. It is considered that there will be a value addition of 10% on the export and 20% value addition on the domestic consumption.

10.2.4 Increase in employment

The proposed development is not only to bring additional employment but also generate the multiplier effect on it. The multiplier effect is expected to be operative due to development

of allied services and activities like cold chain transportation, better auction system etc. along with other support services. The distribution of the benefits of the multiplier effect will mostly reach to the coastal community including the fishing community. It is considered that benefits due to multiplier effect will be 20% of the existing production and other benefits together.

10.2.5 Reductions in dead-time

The proposed investment will reduce the over-crowding, speed up turn around time, reduce time for unloading fish, reduce crew travel time etc. This freed-time will be used either for additional fishing or for leisure time. In the allied primary sector activities like forestry, fishing or animal husbandry, the labour force constitute majority of the production cost. Fishing sector particularly in the oil countries has comparative advantage of low cost fuel. When the fuel cost is lower, the labour component in the fishing is considered 40% of the total production cost. This is also considered that the freed time will save around 50% of the labour cost and add to the leisure time.

10.2.6 Changes in boat mileage

Boat mileage will improved due to preventing harbor closing down; improve access to the harbors so that vessels can land their fish closer to the fishing and grounds and improved mileage for inducing the capacity to change from the traditional fishing boats to modern fishing vessels. This benefit is considered as 5% of the total production cost. It is considered that in the with project scenario the fishing cost will be 70% of the total revenue.

10.2.7 Non Fishing Benefits

The developments of the fishing harbor infrastructure also add value to the national economy through enhanced tourism and

leisure activities. The quantum of non-fishing benefits is considered 3% of the total production value.

The quantified benefits of the project are presented in the following Table 7.

Table 7: Estimated Project Benefits *(In Million RO)*

Year	*Additional Fish Landing*	*Reduction in O & M Cost*	*Quality Value Addition on Export*	*Quality Value Addition on Domestic*	*Time value of reduction in Dead Time*	*Changes in Boat Mileage*	*Non Fishing Benefits*	*Employment Benefit Multiplier effect*	*Total Benefits*
2013	1.02	0.509	0.31	0.41	1.02	0.18	0.10	0.71	4.249
2014	1.08	0.540	0.32	0.43	1.08	0.19	0.11	0.75	4.509
2015	1.16	0.579	0.35	0.46	1.16	0.20	0.12	0.80	4.827
2016	1.30	0.648	0.39	0.52	1.30	0.23	0.13	0.90	5.404
2017	1.37	0.687	0.41	0.55	1.37	0.24	0.14	0.96	5.734
2018	1.46	0.731	0.44	0.59	1.46	0.26	0.15	1.02	6.103
2019	1.60	0.799	0.48	0.64	1.60	0.28	0.16	1.11	6.667
2020	1.72	0.861	0.52	0.69	1.72	0.30	0.17	1.20	7.180
2021	1.88	0.942	0.57	0.75	1.88	0.33	0.19	1.31	7.858
2022	2.01	1.007	0.60	0.81	2.01	0.35	0.20	1.40	8.403
2023	2.10	1.052	0.63	0.84	2.10	0.37	0.21	1.46	8.775
2024	2.30	1.150	0.69	0.92	2.30	0.40	0.23	1.60	9.594
2025	2.45	1.227	0.74	0.98	2.45	0.43	0.25	1.71	10.23
2026	2.59	1.296	0.78	1.04	2.59	0.45	0.26	1.80	10.82
2027	2.80	1.400	0.84	1.12	2.80	0.49	0.28	1.95	11.68
2028	3.08	1.539	0.92	1.23	3.08	0.54	0.31	2.14	12.84
2029	3.26	1.628	0.98	1.30	3.26	0.57	0.33	2.26	13.58
2030	3.44	1.720	1.03	1.38	3.44	0.60	0.35	2.39	14.35

11.0 The Project Return

Economic analysis is carried out to assess the feasibility of the investment proposal. Doing so, as stated above, the discounted cash flow technique is adopted. In this technique all the cost and benefit components are consider and the net effect on the

project is verified in terms of IRR and the NPV. Though DCF technique the project IRR and the net present values are estimated and presented in the following Table 8.

The economic internal rate of return (EIRR) of the project is found 15.62% which is well above the desired cut off rate of 12%. The net present value (NPV) of the project is found 8.80 Million RO. Thus the project is found viable on economic consideration.

Table 8: Net cash Flow of the Project (*In RO Million*)

Year	***Cash Outflow***			***Cash Inflow***	***Net Cash Flow***
	Capital Cost	***Maintenance Cost***	***Total Cost***	***Total Benefits***	
2011	19.05		19.05	0.000	-19.05
2012	12.70		12.70	0.000	-12.70
2013		0.64	0.64	4.249	3.61
2014		0.64	0.64	4.509	3.87
2015		0.64	0.64	4.827	4.19
2016		0.64	0.64	5.404	4.77
2017		0.64	0.64	5.734	5.10
2018		0.64	0.64	6.103	5.47
2019		0.64	0.64	6.667	6.03
2020		0.64	0.64	7.180	6.54
2021		0.64	0.64	7.858	7.22
2022		0.64	0.64	8.403	7.77
2023		0.64	0.64	8.775	8.14
2024		0.64	0.64	9.594	8.96
2025		0.64	0.64	10.233	9.60
2026		0.64	0.64	10.815	10.18
2027		0.64	0.64	11.682	11.05
2028		0.64	0.64	12.839	12.20
2029		0.64	0.64	13.581	12.95
2030		0.64	0.64	14.346	13.71
EIRR					***15.62%***
NPV @ 12% Discount in Million RO					***8.80***

12.0 Sensitivity Analysis

The robustness of the project's viability is further demonstrated by the sensitivity analysis. The sensitivity analysis carried out with the following scenarios.

i) Increase in cost by 15 percent

ii) Decrease in benefits by 15 percent

iii) Increase in cost by 15 percent and decrease in benefits by 15 percent

The results of the sensitivity analysis are presented in the following Table 9.

Table 9: Sensitivity Analysis Results

Case	*EIRR (in %)*	*NPV @ 12% (In Million RO)*
Base Case	15.62	8.80
Increase in cost by 15 percent	13.56	4.18
Decrease in benefits by 15 percent	13.24	2.86
Increase in cost by 15 percent and decrease in benefits by 15 percent	11.31	(-1.76)

Figures in parenthesis shows negative

The sensitivity analysis shows that the project is remain viable in the cases of 15% increase in the cost and also 15% reduction in benefit. However the project marginally falls short of viability in the worst case where the cost will increase and simultaneously the benefit will decrease. However, the probability of occurrence of the worst is minimum and there is a remote chance that the project will be unviable. Even if also, owing to the social benefits to the fishing community the project is desirable.

13.0 Conclusion

From the economic analysis the conclusion is emerged as follows:

In the base case the project is found viable and estimated EIRR is well above the recommended cut off rate. The project clears the sensitivity test except the worst case. In the worst case, the EIRR marginally fall short of the desired rate. On the basis of economic analysis, the project is strongly desirable and recommended for implementation.

REFERENCES

Andrew F. Haughwout, *Public Infrastructure Investments, Productivity and Welfare in Fixed Geographic Areas*, Journal of Public Economics (March 2002) 83(3): 405-428.

Asian Development Bank, *Handbook for the Economic Analysis of Water Supply Project,* Manila, Philippines, Chapter 5, pp-122-135

David Alan Aschauer, *Is Public Expenditure Productive?* Journal of Monetary Economics, 23(2) (March 1989): 177–200.

Edward M. Gramlich, *Infrastructure Investment: A Review Essay*, Journal of Economic Literature, 32(3) (September 1994): 1176–1196.

European Conference of Ministers of Transport(ECMT), *Private and Public Investment in Transport*, Paris, France, 1990.

Isbell, John, *Maritime and Infrastructure Impact on Nike's Inbo und Delivery Supply Cha-in*, TRB Freight Roundtable, 2006. (http://www.trb.org/conferences/FDM/Isbell.pdf.)

Jones Edward and et. al., *Ecological Economics: An Introduction*, Blackwell Science, Oxford, 2000.

Lim, C.S., *Private Participation System in Port Development Projects,* IAME 2002 Panama Conference Proceedings, 13-15 November 2002, Panama.

Muso, E., *Lecture notes on Advance Port Economics,* ITMMA, Antwerp, 2004.

Wiegmans, B. W., Ubbels, B., Rietveld, P., and Nijkamp, P., *Investment in Container Terminals: Public Private Partnerships in Europe*, International Journal of Maritime Economics, 2002.

Theodoros, A. et. al. *Financial Analysis and Life Cycle Assessment for the Construction of A Fishing Harbor at Strymonas River,* 47th Congress of the European

Regional Science Association: Local Governance and Sustainable Development, Aug. 29 to Sept. 2, 2007, Paris.

UNESCAP, *Commercial Development of Regional Ports as Logistics Center*, United Nations, New York, 2002.