CHAPTER – VII

TITANIUM: ECONOMIC RETURN ANALYSIS

7.1 General

India is one of the huge markets comprising many manufacturers, exporters and suppliers of titanium dioxide. These vendors of titanium dioxide are scattered all over Indian markets nurturing the requirements of large variety of buyers of titanium dioxide who are also scattered throughout India. Different varieties of titanium dioxide are available for different industrial purpose. The prime importance for the buyer is to choose the quality titanium dioxide, which also suits his requirement and pocket/budget thus increasing his production and profits.

7.2 Economic Returns for Titanium

This part attempts to analyse the economics of value addition of titanium minerals in Tamil Nadu. Three measures of economic return viz. Net Present Value (NPV), Internal Rate of Return (IRR) and Simple Pay Back Period analysis are used in this estimation. The NPV of the project is calculated at various rates and is presented in a graphical form. This section also tries to identify some of the important factors to which the IRR is sensitive. The return of the project is estimated at 2007-08 prices for titanium. The results of the economic viability study are discussed under three main heads: (a) revenue estimation, (b) return estimation, and (c) risk impact analysis.
(a) Revenue Estimation

Annual revenue of the titanium mining enterprise is calculated by taking into consideration the annual throughput, percentage of minerals found in the mineral sand, recovery efficiency of the titanium mining technology and the prices of minerals. Here considering the reserve found in the study area, the present technology of the titanium mining and the market, the study has assumed the capacity of the plant to be 3,000 tonnes throughput per year. The price of titanium is considered from the publications of Indian Bureau of Mines, Nagpur for the year 2007-08 and annual revenue estimation is based on this data. Annual revenue of the titanium mining venture is estimated to be equal to `1,365 lakhs.

(b) Return Estimation

The economic return analysis as explained in the methodology is carried out by employing the standard budgeting techniques viz., Net Present Value (NPV), Internal Rate of Return (IRR), and simple payback period. In this study, the cost and revenue estimation analysis showed that for the base case, the capital cost, operating cost and annual revenue of the titanium mining unit are `1,757.94 lakhs, `1,033.53 lakhs and `1,365 lakhs respectively. The payback period of the titanium mining venture is estimated to be of 5.27 years. This clearly indicates that the investment in titanium mining business in Tamil Nadu is paid back in a short period. Figure 7.1 shows the net present values for different discount rates. Here, discount rate is shown on the ‘x’ axis and net present value on the ‘y’ axis. As
stated above, internal rate of return is that discount rate which makes net present value of the project zero. Since the curve touches the ‘x’ axis at 26.75 where the net present value is zero, the internal rate of return takes the same value. This indicates the economic feasibility of titanium mining in the study area.

In short, the above analysis explains that the titanium mining plant, with a capital cost, operating cost and annual revenue of `1,757.94 lakhs, `1,033.53 lakhs and `1,365 lakhs respectively, generates an internal rate of return of 26.75 per cent which is deemed to be well above the present market rate of interest (12.50 per cent rate of interest, State Bank of India, 2010) in India. When export of ilmenite brings `5,500 per tonne, the value added ‘titanium’ fetches `45,500 per tonne on export, it proves that the value addition increases the economic returns and thus the second hypothesis is proved.
(c) Risk Impact Analysis

The risk impact analysis has been worked out with respect to the unforeseen changes expected to occur greatly in capital cost, operating cost, electricity cost and annual revenue.

Capital Cost

In applying the sensitivity analysis, a high risk is attached to the capital cost. It is studied in the context when the capital cost is varied up and down by 10 and 25 per cent. The effects of 10 per cent changes in capital cost on the
profitability of the project are estimated and the results are given in Figure 7.2. The IRR for the case of 10 per cent increase in capital cost is 24.10 per cent and the payback is 5.80 years. For the 10 per cent decrease, the IRR increases to 29.80 per cent and the payback period decreases to 4.75 years. It is here observed that an unexpected rise of capital cost by 10 per cent does not significantly affect the profitability of the titanium mining unit in the study area. Therefore the third hypothesis that “a 10 per cent variation in the capital cost does not affect the economic feasibility of this venture” is true.

**Figure: 7.2 – Sensitivity of NPV’s at 10% Variation in Capital Cost**
The major component of capital cost is the machinery cost. Since some of the sophisticated machines are imported from outside India, price changes in the foreign markets and volatile exchange rates affect the capital cost more. In addition to this, the prices of building materials like cement and steel also fluctuate steeply. So to accommodate these kinds of high risks associated with the capital cost components and the subsequent changes in the feasibility of the project, the capital cost is varied up and down by 25 per cent from the base case. The capital cost works out to be `2,184.93 lakhs for an increase of 25 per cent case. In this case, the IRR reduces to 22.20 per cent and the pay back period increases to 6.59 years. On the other hand, for the case of a decrease by 25 per cent, the IRR increases to 36.30 per cent and the pay back period reduces to 3.95 years. Figure 7.3 represents NPV and IRR values for 25 per cent up and down changes in the capital cost from the base case. Hence, a decrease and an increase of the capital cost by 25 per cent, do not significantly affect the profitability of the titanium mining venture. Therefore the third hypothesis is verified and found true.
Figure: 7.3 – Estimation of NPV’s at 25% Variation in Capital Cost

Operating Cost

The major components of operating cost are the wages paid to the labourers, technicians, and managers, the charges paid to the consumption of fuel and electricity and the expenses on maintenance and repair. It is obvious that in recent years the prices of fuel in the form of oil and gas and electricity are fluctuating. Such fluctuations affect the profit earning capacity of the titanium mining unit through operating cost. Hence, the operating cost is increased and decreased by 10 and 25 per cent on both sides of the base case.

The results of the sensitivity analysis of operating cost for plus or minus 10 per cent are shown in Figure 7.4. For 10 per cent upward shift in operating
cost, IRR declines to 18.10 per cent from 26.75 per cent of the base case. A 10 per cent downward shift in the operating cost improves the rate to 36.10 per cent. The payback period for the respective cases is calculated to be around 7.66 and 4.02 years. Therefore the third hypothesis is true.

**Figure: 7.4 – Sensitivity of NPV’s at 10% Variation in Operating Cost**

Similarly, the influence of 25 per cent upward and downward changes in the operating costs are attempted here. The estimation shows that a 25 per cent increase in operating cost, reduces IRR to 17.20 per cent and a 25 per cent decline in operating cost raises the internal rate of return to 46.10 per cent from the base case IRR of 26.75 per cent. The pay back periods for the 25 per cent up and down cases are 7.83 years and 2.96 years respectively. The sensitivity of net present
values for 25 per cent changes in the operating cost is given in Figure 7.5. The major inference of the analysis is that 10 and 25 per cent variations in operating cost do not affect the profitability of the venture to a great extent. Therefore the third hypothesis is proved.

**Figure: 7.5 – Estimation in NPV’s at 25% Variation in Operating Cost**

![Graph showing NPV variation with discount rate for different operating costs](image)

**Electricity Cost**

The major component of operating cost is electricity. In recent years the prices of fuel and electricity are fluctuating. Such fluctuations affect the profit earning capacity of the titanium mining unit through operating cost. Hence, the influence of electricity cost over profit is thus tested when this cost is increased or decreased by 10 and 25 per cent on both sides of the base case.
The results of the sensitivity analysis of escalation of electricity cost by 10 per cent are shown in Figure 7.6. For 10 per cent upward shift in electricity cost, IRR declines to 26.50 per cent from 26.75 per cent of the base case. A 10 per cent downward shift in the electricity cost improves the rate to 29.25 per cent. The payback periods for the respective cases are calculated to be around 5.55 and 5.03 years.

**Figure: 7.6 – Sensitivity of NPV’s at 10% Variation in Electricity Cost**

On the other hand, regarding the electricity cost, an increase by 25 per cent, the IRR decreases to 23.50 per cent and the payback period increases to 6.01 years and a 25 per cent decline in electricity cost raises the internal rate of return to 30.25 per cent from the base case IRR of 26.75 per cent. The payback period for the 25 per cent fall is 4.70 years. Figure 7.7 represents NPV and IRR values for
25 per cent variation in the capital cost from the base case. Hence, a decrease and an increase of the electricity cost by both 10 and 25 per cent, significantly affect the profitability of the titanium mining venture.

**Figure: 7.7 – Sensitivity of NPV’s at 25% Variation in Electricity Cost**

![Graph showing NPV sensitivity to electricity cost variations](image)

**Annual Revenue**

High risks of power failures, labour union strikes, instability in the foreign prices of titanium minerals, unfavourable trade policies, etc., may affect the annual revenue of the project. To verify the extent of influence of the above factors on the profitability of the titanium mineral unit, an estimation is undertaken when annual revenue is increased and decreased by 10 and 25 per cent from its value of the
base case. For the case of 10 per cent increase in the annual revenue, the IRR stands at 38.25 per cent and for a decrease of 10 per cent the IRR declines considerably to 14.50 per cent. Figure 7.8 represents the relation between the NPV’s and the discount rates for 10 per cent fluctuations in annual revenue from the base case. The pay back periods for the 10 per cent upward and downward revision in the annual revenue are 3.74 years and 8.97 years respectively. Therefore, the third hypothesis that ‘a 10 per cent variation in the important parameter that is, annual revenue does not affect the economic feasibility of titanium processing.

**Figure: 7.8 – Estimation of NPV’s at 10% Variation in Annual Revenue**
When the annual revenue is raised by 25 per cent, that is, from `1,365 lakhs to `1,706.25 lakhs, then the cash flow works out to be at `672.72 lakhs. For this case, IRR is calculated to be at 50 per cent with a pay back period of 2.60 years. If annual revenue is decreased by 25 per cent, that is, from `1,365 lakhs to `1,023.75 lakhs, then cash flow decreases to `209.78 lakhs. In this analysis the internal rate of return and the pay back period are estimated to be at 12.10 per cent and 8.33 years, respectively. Here, the profitability of the project is found to be considerably affected by the decrease of annual revenue by 25 per cent. Therefore, the third hypothesis is untrue.

Results of the sensitivity analysis showed that the fluctuations in the annual revenue not affect the profitability of the titanium mining venture greatly. This substantiates the contention that the annual revenue is also the most important factor influencing the profitability of the titanium mining venture.
Inference of Economic Return Analysis

The economic viability analysis adopted for titanium mining venture in Tamil Nadu in India, exhibits that the titanium mining is feasible. The feasibility expressed in the form of IRR is well above the market rate of interest, and also well above the average of the mining industries in the offshore and on-shore area.

Hence, it is suggested that the importance with regard to research and development given to the deep ocean mining by the Government of India through its ministries like the Department of Ocean Development, may also be extended to titanium mining. A favourable government policy at this juncture may arouse the
interest of the business community to come with new investments and this may help to generate employment opportunities, export and income of the people.

The researcher concluded that instead of exporting ilmenite mineral as concentrates, if they are exported in the form of value added products such as titanium dioxide which will fetch comparatively more earnings. For example, the export of ilmenite concentrates brings a maximum export price of `5,500 per tonne whereas, its value added product ‘titanium pigment’ brings a price of `45,500 per tonne. Therefore the value addition is the most important factor which determines the profitability of titanium processing. Hence, the second hypothesis is held true.

The risk impact analysis has been worked out with respect to the unforeseen changes expected to occur greatly in capital cost, operating cost, and annual revenue. Hence, a 10 per cent and 25 per cent variation in the important parameters that is, capital cost, operating cost and annual revenue except 25 per cent decrease in annual revenue, do not affect the economic feasibility of value added ilmenite venture and the third hypothesis is held true.

In India, there exists a peculiar situation wherein imports of many final products take place even though it has rich resources of the respective raw materials. This situation also persists in the case of titanium metal (India Infoline Ltd., 2001), abrasive ilmenite, rutile and zircon. The titanium mineral industry’s capability of producing export surplus can be improved by a proper R&D effort and this will make the economy self-reliant in this field.
7.3 Overview

This chapter deals with the economic returns of titanium. There are three measures of economic return viz. Net Present Value (NPV), Internal Rate of Return (IRR) and simple payback period analysis are used in this estimation. The NPV of the project is calculated at various rates and are presented in graphical form.

The titanium mining plant, with a capital cost, operating cost and annual revenue of `1,747.94 lakhs, `1,033.53 lakhs and `1,365 lakhs respectively generates an internal rate of return of 26.75 per cent which is deemed to be well above the present market rate of interest in India.

The researcher concluded that value added know-how is the driving force that makes the titanium industry viable. The researcher also suggests that as this industry is capital intensive in nature and therefore government funding at reasonable interest rate is necessary to induce private players to undertake such industries. A public-private model is very much welcome.