FEASIBILITY ANALYSIS OF THE ETHANOL REFINERY IN MAHARASHTRA

STUDY ORIENTED PROJECT

Submitted by

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ABSTRACT

The paper aims at simulating the cost of setting up the ethanol industry in state of Maharashtra by considering all the fixed and variable cost variables. Monte Carlo Simulation technique is used to simulate the 500 observations for the cost parameters and other accounting variables. The stochastic simulation of all the accounting variables is done and the probability density function of the NPV for 5, 10 and 15 years is plotted. It is shown that the probability of the economic success from the probability density function of the NPV is 100%. Moreover it is noted that it is not only economically feasible to setup a plant but also profitable at a considerable margin.

Keywords: Monte Carlo Simulation, Feasibility analysis, NPV

Introduction:

Due to the increasing energy demand at the annual rate of 4.8% of the growing population of India, the depleting reserves of the non-renewable conventional sources of energy and huge levels of the emission of greenhouse gases there is need to look for more safe and renewable sources of energy. Biofuels is the answer for the above problem which is produced from the renewable energy resource biomass. This biomass is obtained from sources like agriculture waste, domestic waste, industrial waste and many others. Ethanol is one such biofuel produced from sugarcane molasses the by-product of the sugar industries. As India is facing an issue of scarcity of food there is food vs fuel debate and many other obstacles in the production of the biofuels. There are many inputs for the biofuel production like sugarcane molasses, corn, and feedstock in the ethanol production, various chemicals and the various processes available like fermentation, transesterification for the conversion of biomass to biofuel. Though there are so many advantages of using the biofuels still not many private players are producing it. It is important to study the feasibility analysis of the Biofuel refinery due to obstacles faced in the production of these biofuels and the learning why it is not provided by the private players. The analysis is important in order to solve the deadly problems like global warming. As mentioned above thus the aim of the research is the feasibility analysis of the setting up an Ethanol refinery in Maharashtra, India.

Literature Review:

Due to the hazardous effects of the Global Warming, most of the countries are heading towards the usage of biofuels to reduce the emission levels of the greenhouse gases. The existing literature has the various studies on the production of various biofuels through different processes and varied biomass inputs. Joseph B. Gonsalves in the paper "An Assessment of the Biofuels Industry in India" have mentioned the various benefits from the use of biofuels not only in the reduced levels of harmful pollutants but also increased employment, decreased dependence on oil imports and improved social wellbeing. A complete economics of ethanol production from molasses has been done which states the cost of producing ethanol from molasses is Rs.18.81 for a standalone distillery. The most dominant factor in the cost is the prices of molasses and there are huge fluctuations in the price of molasses as they depend on the price of sugar, season drought and the Indian control politics between central and state government. The paper provides some measures for the better ethanol production like the improved practices for sugarcane yield, other feed stocks like sweet sorghum and tropical sugar beetroot, using the enzymatic fermentation of cellulose for ethanol manufacture and improved methods of producing anhydrous ethanol. The paper by Hossein Shapouri and Michael Salassi mentions various tactics for reducing the costs of ethanol production through the feasibility analysis of the ethanol industry of United States. The optimal location of an ethanol production facility should be near to its feedstock supply, regardless of the feedstock. In United States most of the ethanol plants producing from corn are within close proximity to the major corn producing areas. Sugar mills in Brazil and United States have become more efficient due to improved technology.

Much higher level of technology like high industrial automation, new separation process, high sucrose recovery and higher fermentation productivity could be adopted to lower the processing cost of sugar cane. The EU and NAFTA policies have been helping the member countries to have trade benefits and thus lowering their costs. Government policies play an important role boosting up a particular industry. The paper by Chad Cotti and Mark Skidmore studies the impact of State government subsidies and Tax Credits in the emerging industry of ethanol production. The state-level per gallon tax credits indeed influence the ethanol plant locations. Though federal subsidies and mandates had led to a notable deadweight loss, certain subsidies should be considered if the objective is to leader in the emerging market. National subsidies or mandates had led to increase in production while the state subsidies affect more location. Moreover the subsidies should be substantial because the costs are too high in some regions. Hearth Gunatilake discusses that the administered prices currently do not provide sufficient financial incentive to produce the biodiesel. It provides a solution to the food vs fuel debate of using the wasteland for the production of the raw material biomass. The intervention of the government is necessary for the sector to take off by correcting the market and non-market failures. The interventions like the allocation of wasteland, provision of incentives for private producers and a dedicated authority for biodiesel would be very useful. Thus the biofuels are important to be produced by the countries through collective actions and the central and state governments of the country should work together to promote the industry.

Data Sources:

The analysis requires collecting data for the various input costs and the input amount estimates for the setup of the biofuel refinery in the state of the Maharashtra. The various government websites and existing literature was used for various estimates required in the analysis. The molasses cost and the fixed cost parameters were taken from ethanol India project, the molasses cost was around Rs. 4000-6000 per tonne. The wage cost for the semi-skilled labour was taken from the Maharashtra website paycheck which lists the wages for the various industries for the last decade. The power rates for Maharashtra were taken from the Industrial power rates India website. The inflation rate and lending rates were taken from the World Bank Database. The various expenses comprising of the chemical cost, the per litre labour and power required were taken from the existing literature by James Richardson's paper "Risk Assessment in Economic Feasibility Analysis: The Case of Ethanol Production in Texas"(2006) and the Joseph Gonsalve's paper on the "An Assessment of the Biofuels Industry in India"(2006).

Methodology:

First the data was collected for the various input variables in calculating the cost of the production of ethanol. To account for the risk in the feasibility analysis and decision making, and the less availability of the time series data on the input cost parameters the Monte Carlo stochastic simulation technique was used. The stochastic simulation generated 500 values for the KOV's key output variables. The normal distribution was used for simulating the 500 values for the wage rates, power rates, lending rates and the molasses cost on the sample time series data collected. While the GRKS distribution was used for the simulation of the chemical, milling, transportation costs, etc. grouped as other expenses and the price of the ethanol to calculate the total revenue generated by the plant for the financial parameter net present value analysis. The mean of the net profit was used to simulate the NPV of the plant for 5, 10 and 15 years. From these NPV the probability distribution function was generated and the probability of economic success was calculated. This economic success probability indicates the feasibility of setting up the biofuel refinery.

Many assumptions were made for calculating the costs and the requirements of the plant in consideration with the existing literature. The assumptions from the literature were modified keeping in mind the current scenario of prices and the various government policies and programmes.

Assumptions:

1. The plant capacity was taken as 8623 tonnes per year i.e. 30k litres capacity per day and the complete analysis is done for the annual production of the ethanol with above mentioned capacity.
2. The plant requires 4 man days to produce per 250 litres of ethanol.
3. For 1 tonne production of ethanol, the plant requires 25 kWH electricity.
4. The 50% of the fixed cost i.e. 34765000 was assumed to be financed through the loan from the banks and remaining 50% was added to the total cost directly.
5. The conversion ratio of molasses to ethanol was taken as 4 kg of molasses produce 1 litre of ethanol.
6. The depreciation was taken as 10% of the Building and civil structure and the plant and machinery costs.
7. The discount rates for calculating the Net Present Value were assumed to be 6.5% and 7% and then the GRKS distribution was run to simulate the values.
8. The demand for ethanol was assumed to be equal to the production of the plant i.e. no production by the plant is left over.
9. The various costs like the chemical cost, steam cost and the transportation cost were grouped as the other expenses part of the cost structure.

Results:

The simulation results from the stochastic simulation of the various mentioned cost parameters are tabulated in Table 1. The total mean cost to produce 8623 tons of ethanol in a year is around 0.29 billion. The per litre cost to produce ethanol from the current plant assumptions and analysis is **Rs.27.05758**.

Variable	Total Fixed Cost (Rs.)	Molasses Cost (Rs.)	Interest Expense (Rs.)	Wage Expense (Rs.)	Power Expense (Rs.)	Depreciation (Rs.)	Other Expenses (Rs.)	Total Cost Rs. (8.6k tons/yr)
Mean	34765000	217282788	4828152	33833969.99	1075447	6953000	3799811.4	296280469
StDev		62147982.7	957753.8	10454990.83	138557.4		72734.437	63767628.3
CV		28.6023496	19.83686	30.90086925	12.8837		1.9141592	21.5227242
Min		37841391.2	1966302	1232226.939	629221.7		3749998	116969339
Max		399404418	7694419	66652651.1	1480472		4115266.8	497149637

Table 1: Simulation results of Cost parameters.[1]

The net profit calculated from the simulation results with the average market price of ethanol as between the 48.50 to 49.50 per litre of ethanol are as shown in Table 2. The net profit is around 0.24 billion. As the average market price of ethanol was taken around Rs.49 per litre and the cost per litre is Rs.27 the profit per litre is Rs.22 which is a considerable amount.

Variable	Total Revenue (Rs.)	Total Cost (Rs.)	Net Profit (Rs.)
Mean	537641721.4	296280469	241361252
StDev	1597031.897	63767628.3	63770799
CV	0.297043892	21.5227242	26.421307
Min	536549997.5	116969339	39400363
Max	545123778	497149637	419580661

Table 2: Simulation results of the Accounting equation

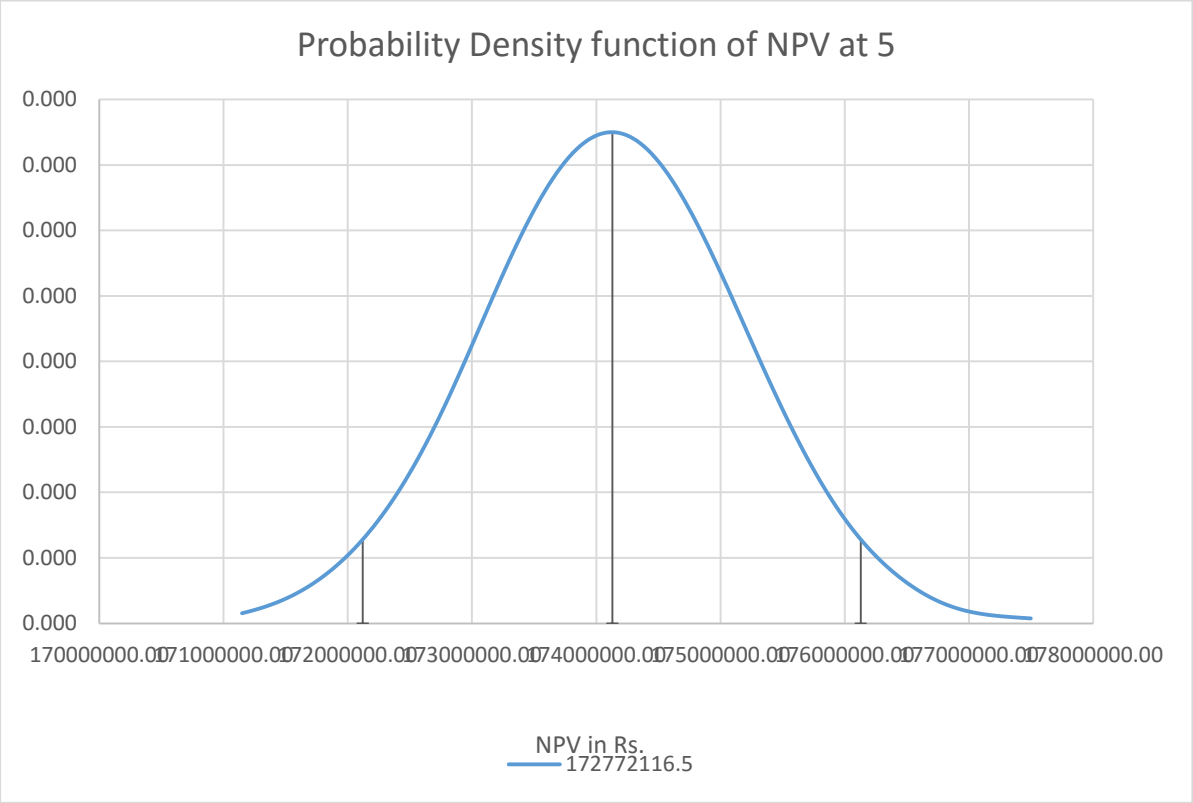
[1] The values in the Table 1,2 & 3 are in Rs. for the plant capacity as 8.6k ton ethanol production in a year.

The Net Present Value was calculated at 5, 10 and 15 years from the mean net profit value taken from Table 2 with the discount rate around 6.5%. The results of the NPV stochastic simulation are tabulated in Table 3.

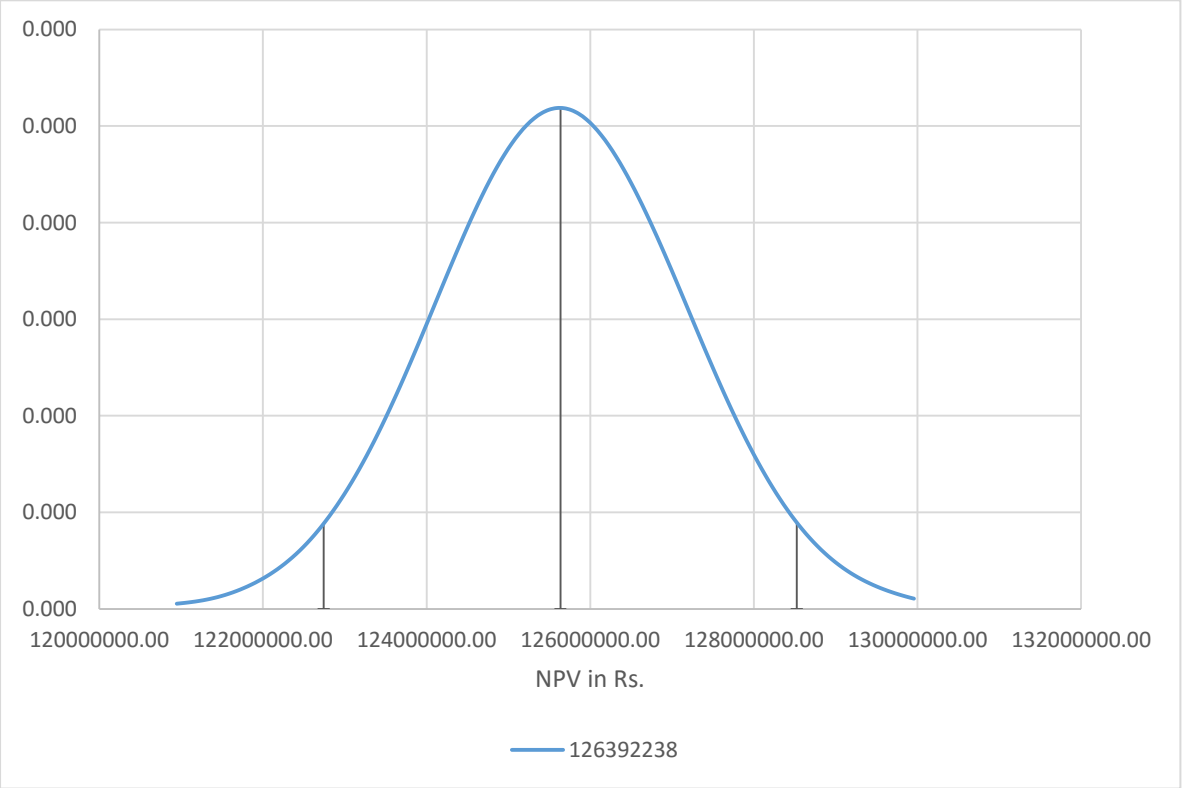
Variable	NPV5 (Rs.)	NPV10 (Rs.)	NPV15 (Rs.)
Mean	174127515.6	125636871.4	90664375.56
StDev	1019887.499	1469011.637	1591746.023
CV	0.585713002	1.169252004	1.755646596
Min	171148912.3	120946690.5	85777749.76
Max	177498149.1	129956478.9	95676229.37

Table 3: Simulation Results of the NPV

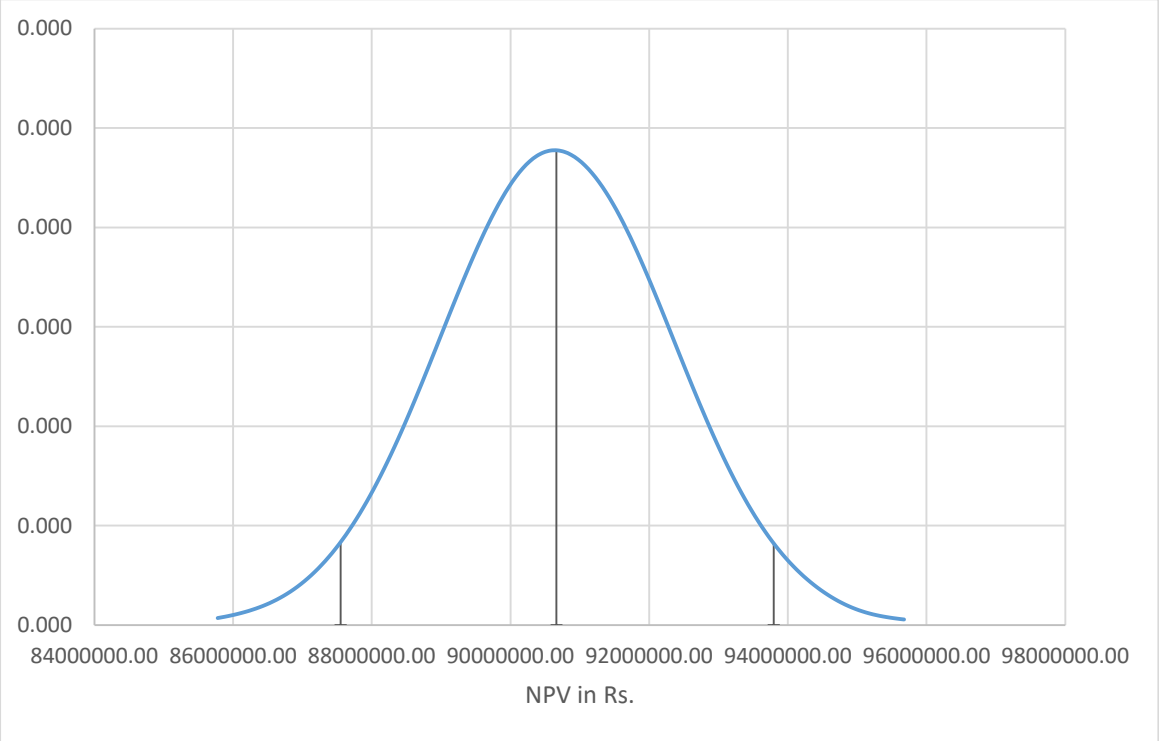
From the NPV values the probability density functions were plotted and all the simulated values were greater than 0, so the probability of economic success is 100%, this can be seen from the graphs below.



Graph 1: NPV for 5 years



Graph 2: NPV at 10 years



Graph 3: NPV at 15 years.

Conclusions:

As the main aim of the paper is to analyse the feasibility of the ethanol refinery in Maharashtra, the stochastic simulation was done for all the accounting variables to account for the risk factor. The profit from the refinery is around 0.24 billion which is huge value for a refinery. This profit value can be seen as lucrative incentive for the private players as well a good revenue source for the government to finance its various activities. The probability density functions of the Net present Value showed the probability of economic success to be 100%. Any price above Rs. 27 will lead to profit. Thus the plant is economically feasible, a good opportunity for making profits for the undertaking players and finally an investment associated with huge positive externality as it will reduce the usage level of the non-renewable and the hazardous fuels. The certainty in the analysis is coherent with the strong existing ethanol industry in Maharashtra.

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