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# Optimal Capital Structure for BOOT/BOT Model Hydropower Projects in Nepal

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## Abstract:

Nepal has a huge hydropower potential which is yet to be developed. Hydropower are capital intensive infrastructure where financing from single source is not practical, so a financial mix is essential, i.e. debt and equity financing. Projects have been practicing different financial structures. Therefore a proper capital structure is necessary for maximizing return from the hydropower project.

The main objective of this research is to determine the parameters that influence hydropower financing, collect data on parameters, analyze them and determine the optimal capital structure for hydroelectric projects in Nepal.

The data of operating hydropower projects are collected from secondary sources mainly Department of Electricity Development, Nepal Electricity Authority and other published internet sources. The data is processed and financial analysis is performed for numerous cases using an excel sheet powered by visual basic application.

The key parameters affecting hydropower financing are total project cost, annual generation (Dry and wet energy), interest on loan and interest on equity while other parameters are not frequently variable. The feasibility of the project is found to be greatly influenced by the cost of development and generation revenue. The optimal capital structure of hydropower projects is dependent on the key parameters.

The cost of hydropower development in Nepal is found to be diverse with an average per megawatt cost of NRs. 219.2 million and standard deviation of NRs. 65.9 million. Energy generation varies from time to time and plant to plant with an average plant factor of 0.53 (Standard Deviation 0.20) out of which 33.16% is dry energy. The cost of loan varies from 8% to 12% and the cost of equity ranges 12% to 16%. The optimal capital structure for BOOT model hydropower projects in Nepal falls in the range of 11% to 34% with an expected value of 20.79%.

***Key words:*** *Optimal Capital Structure, BOOT model, Hydropower Financing, Cost of hydropower*

## 1. Introduction

Nepal has huge hydropower potential and water resource is connected with the economic development of Nepal. The history of hydropower in Nepal dates back to 1911 AD but hydropower development was opened for private sector in 1992 AD only. One of the major strategies in power sector is promoting private sector participation in power generation. 51 projects totaling 910.311 MW from the private sector are awaiting financial closure (1). Hydropower Projects are capital intensive that requires huge investment. Nepalese financial sector has identified hydropower as lucrative financing opportunity and it is meaningless to ask for mortgage for financing above 1 billion rupees(2).

Project financing is a debt financing scheme in which no additional collateral is sought except the project, its assets and projected cash-flow. Capital Structure is the relative proportion of the financing instruments used in a business.The capital structure of project depends on variables such as total project cost (TPC), profit before interest and tax (PBIT), annual revenue (R), annual operation and maintenance cost (OM), depreciation (DEP), and debt and interest (D)(3).

Currently in Nepal, various projects have practiced various capital structures but there is no standard practice. Profitable Capital investment leads to growth and prosperity of economy else investment will shrink (4). Therefore, a capital structure that is most profitable to the investors is essential for growth and prosperity.

## 2. Financial Evaluation of Project and Optimal Capital Structure

Financial evaluation of project is the assessment of financial viability of the project. The most popular techniques are the net present value criterion methods, the internal rate of return method, external rate of return method, return on investment method, benefit/cost ratio method and payback period method (4).Guidelines for study of hydropower projects 2003 requires financial internal rate of return (FIRR) and the loan reputability to be examined based on financing conditions. The financial evaluation of the projects is performed on the following basis:

- Life of plant is considered as 30 years as generation license is issued for 35 years including construction period.
- Discount rate is taken as the weighted average cost of capital
- Annual Revenue (AR) is the revenue from sales of energy to Nepal Electricity Authority as per long term Power purchase Agreement.
- Operation and Maintenance cost (O&M) is taken as 2% of Total project cost & escalated by 3% each year
- Insurance costs (In) is taken as 1% of total project cost
- Operating Revenue (OR) = AR – O&M - In
- Straight line depreciation(Dp) method is used with salvage value of project as zero. 3.33% of total project cost is depreciated each year.
- Earnings before Interest and tax (EBIT) = OR – Dp
- Earnings before tax (EBT) = EBIT – Interest on Loan (I)
- Capacity Royalty (CR) NRs. 100/kW upto 15 years and NRs. 1000/kW after 15 years operation
- Energy Royalty (ER) 2% of AR upto 15 years and 10% of AR after 15 years operation
- Corporate Tax (CT) 20% for hydropower, tax holiday of 10 years and 50% off for next 5 years after operation
- Net Profit = EBT – CR – ER – CT
- Net Cash available before Principle Repayment (NCABPR) = Net Profit + Dp
- Staff Bonus 2% of net profit
- Project Cashflow (PC) = NCABPR + I (after commissioning, before commissioning cashflow in project development)
- Cash flow to Equity (CFE) = NCABPR – Principle Repayment – Bonus Allocated

The following indicators are used for evaluation

- Return on Equity, obtained by solving the following equation where E1 & E2 are equity spent durig year 1 & 2 of construction

$$-E_1 - \frac{E_2}{(1+RoE)^2} + \sum_{i=1}^{30} \frac{CFE_i}{(1+RoE)^{i+2}} = 0$$

- Net Present Value $(NPV) = -PC_{-1} - \frac{PC_0}{(1+WACC)^1} + \sum_{i=1}^{30} \frac{PC_i}{(1+RoE)^{i+1}}$

- Benefit Cost Ratio $(B/C)\ Ratio = \sum_{i=1}^{30} \frac{PC_i}{(1+RoE)^{i+1}} \Big/ \left(PC_{-1} + \frac{PC_0}{(1+WACC)^1}\right)$

The word optimum means most conducive to a favorable outcome. Hence, Optimal Capital Structure is the most advantageous proportion of debt and equity. The research is based on the investors' point of view; hence, maximum return on equity is the favorable outcome.

## 3. Data Collection and Analysis

The analysis of data is performed on the following assumptions:

i. The scope of this research is limited to a BOT or BOOT model hydropower projects in Nepal
ii. The analysis is done in the light that Nepal Electricity Authority performs a long term power purchase agreement and purchases all the energy at the agreed rate. All the energy is sold.
iii. The parameters taken are within the Nepalese Legal framework for hydropower
iv. The loan period is considered as 10 years
v. The debt repayment starts only after the commissioning of the project. The project (Special purpose Company) shall repay its debts in equal installments for the whole loan period.
vi. The lower the equity, the higher the risk of default as the project fails to comply with its loan repayment requirements. In case of default, the project is not feasible.

There are sixty (60) operational projects listed in website of Department of Electricity Development (DoED) as on 24 May 2017 out of which 45 are owned by private sector. Projects of 1-25 MW installed capacity operational for more than one year are sampled for the study on the basis of availability of data.

The data for total project cost is obtained from internet sources and documents submitted to NEA. The data for inflation are obtained from the World Bank sources. The energy generation is obtained from the royalty management system of DoED and NEA power trade department. Thecost of loan and equity are extracted from the interest rates data from internet sources.

Financial analysis is performed for each set of data by changing the equity proportion. The equity proportion that yields the maximum return on equity is the optimum equity. The project should be feasible and able to repay its debt obligations in order to determine optimal capital structure. Each set of data consist a pair of total project cost and annual generated energy. The cost of debt is taken in the range of 8% to 12% and cost of equity is taken in the range of 12% to 16% at interval of 1% with each value equally likely. Therefore, for each set of data twenty five cases are evaluated. The evaluation is performed using an excel sheet backed up by visual basic application.

## 4. Findings and Interpretations

The key parameters influencing hydropower financing can be categorized into project specific characteristics and existing policies. The project specific characteristics like Total project cost, annual generation, interest on loan and interest on equity are found to change frequently and are considered as variables in the study. The policies are found to be relatively stable so, are not considered as variables.

The cost of hydropower development in Nepal is seen to be NRs. 219.2 million with a standard deviation of NRs. 65.9 million at 2016 January price level.

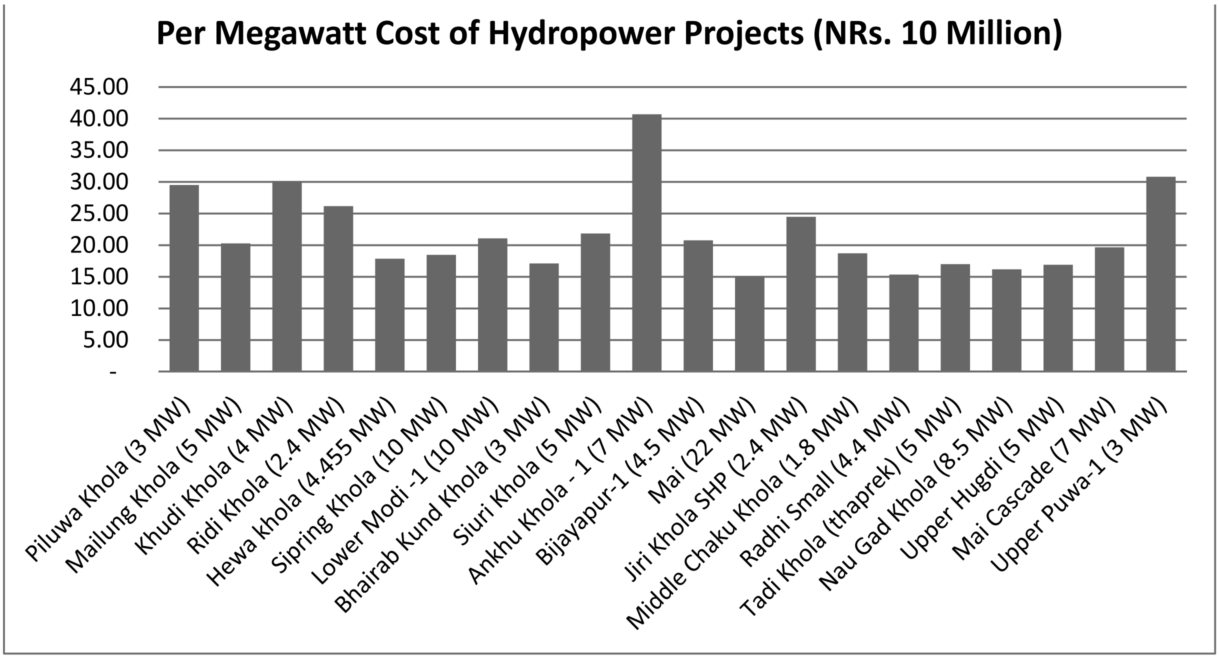
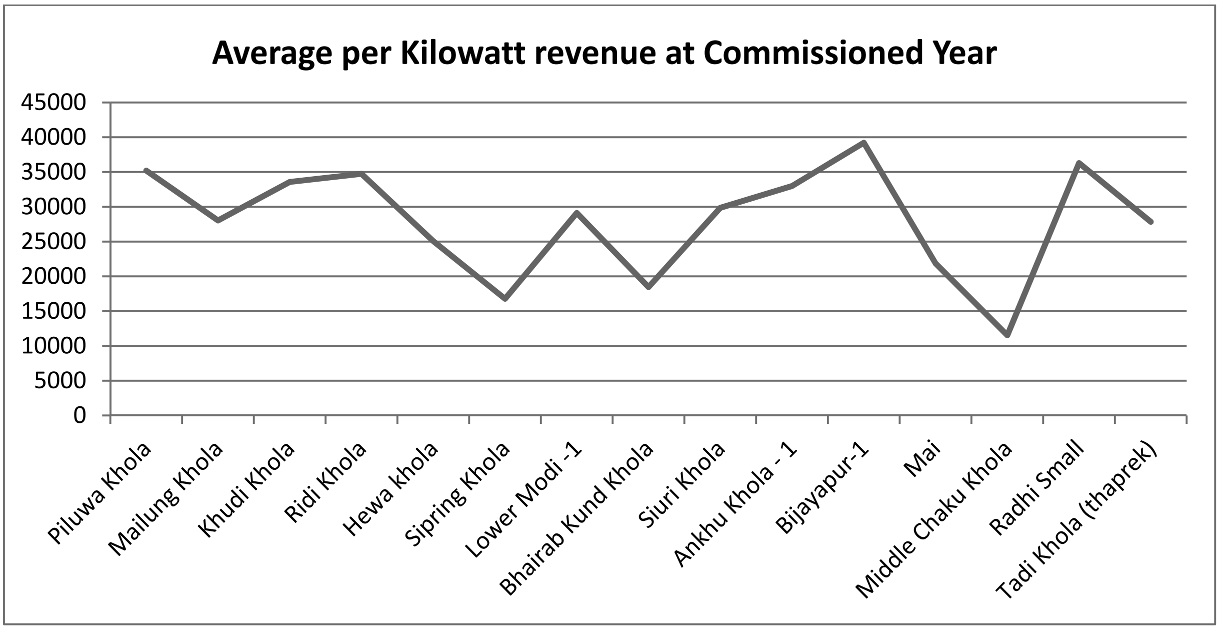



Figure 1: Per Megawatt cost of Hydropower Projects in Nepal

The plant factor of the project is 0.53 in average with a standard deviation of 0.20 out of which 33.16% energy is dry energy with 10.25% standard deviation.




The cost of debt financing hydropower projects is found to be 8% to 12% derived as per the consortium agreement subject to the base rate.

The risk free rate of investment is taken as the interest rate of the fixed deposit accounts of banks and financial institutions. Eight out of thirty one financial institutions pay 12% or above at fixed deposit, so, 12% is found to be the minimum cost of equity as investors seek a minimum return equal to risk free rate. The cost of burrowing the funds is taken as the opportunity cost of such funds invested as equity. Almost all Bank and financial institutions provide non corporate loans at 16%. Therefore, cost of equity is taken from 12% to 16% at 1% interval with each values equally likely.

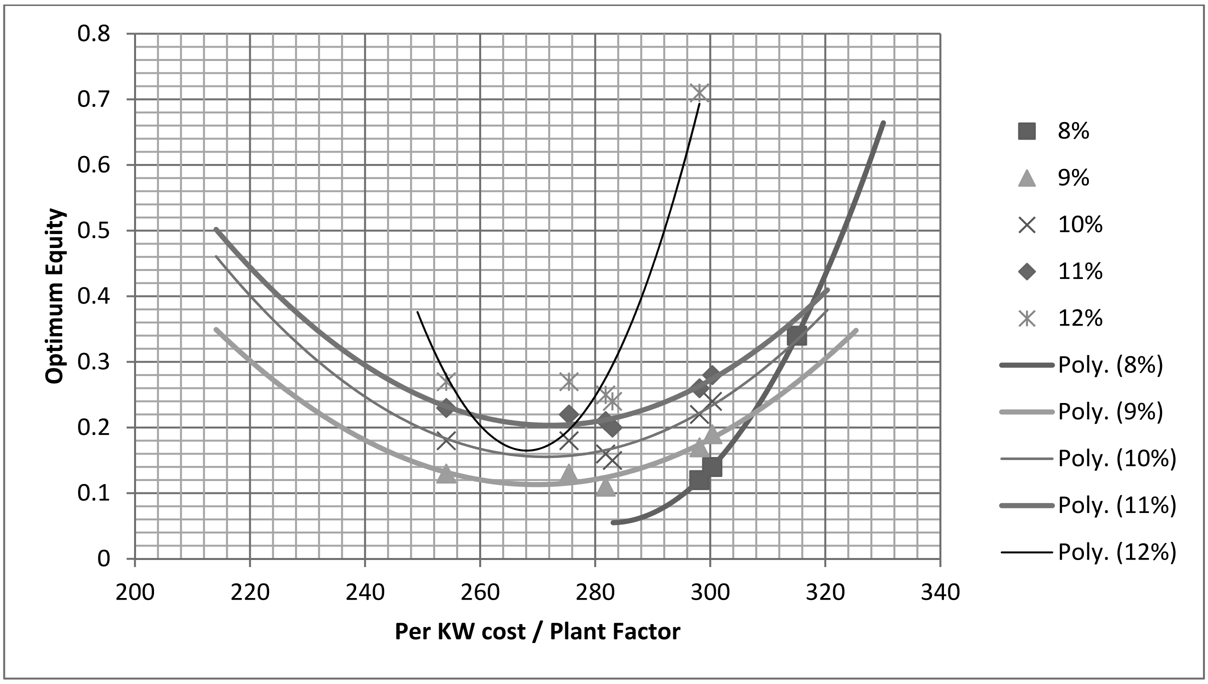
Analysis shows that there occur most cases where the projects are not feasible during the financial analysis. 823 cases out of 1000 cases resulted in project being unfeasible. 3.4% of the feasible cases showed that equity is cheaper than loan financing while 28.25% of the feasible cases showed that debt financing is cheaper than equity. 68.36% of feasible cases showed that there exists a tradeoff between debt equity and their associated costs. These cases resulted in a value of optimal capital structure for each case. The optimal capital structure for BOOT/BOT model hydropower projects in Nepal is 11% to 34% with expected value of 20.79% and 0.033% standard deviation.

The optimal equity is given by the relation;

$$Y = M0*X0 + m1*X1 + m2*X2 + m3*X3 + M4*X4 + M$$

Where the variables and coefficients are;

| Description | Variable | Coefficients (M) | Standard Error |
|---|---|---|---|
| Intercept (M) | Intercept | -0.374725318 | 0.066993508 |
| X Variable 1 (X0) | Total Project Cost per KW | 4.43512E-06 | 3.40731E-07 |
| X Variable 2 (X1) | Interest on loan | 5.052364015 | 0.321193031 |
| X Variable 3 (X2) | Interest on Equity | 0.152839976 | 0.254608365 |
| X Variable 4 (X3) | Dry Energy Plant Factor | -1.691820015 | 0.152268745 |
| X Variable 5 (X4) | Wet Energy Plant Factor | -0.885688726 | 0.133101643 |




## 5. Conclusions

The following conclusions have been made from the study:

1. The cost of hydropower development is diverse with mean NRs. 219.2 million and standard deviation NRs. 65.9 million. The per megawatt cost fits Burr distribution with parametersk = 0.1113, α = 29.789, β = 15.708 and γ = 0.
2. The feasible projects have negligible risk of bankruptcy as all the energy is sold by a long term PPA with NEA
3. There is a tradeoff between debt, equity and their associated costs. The optimal capital structure is 11% to 34% with an expected value of 20.79% for maximum return on equity.

The project costare diverse and most of the cases are found to be unfeasible on operational characteristics, so, a probabilistic approach to financial analysis must be adopted during financial closure. The project cost should be controlled as; most unfeasible cases are unable to repay their debt obligations.

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