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Relative Importance of Risks in Hydropower Projects and Project Finance in Nepal

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ABSTRACT

Hydropower is the sole internal source of electricity in Nepal. Since the government policy of private participation in hydropower sector launched, Independent Power Producers (IPPs) have gained significant presence under Public-Private Partnership (PPP) model of infrastructure development. Risk management is crucial in PPP projects as mishandling of any risk threatens sustainability and may result in project failure. This study analyses four major risks including Hydropower Sector Specific Risks, Project Finance Specific Risks, Hydropower Project Financing Risks and Country Specific Political and Legal Risks. Self-administrative survey utilizing questionnaire was conducted among the IPPs and domestic Banking and Financial Institutions (BFIs). Relative Importance Indices have been used to determine the importance of each risk item. Exchange rate changes, currency mismatch between local revenue and foreign loan, cost and time overrun, inflation, political turmoil and highly volatile political environment are few of the most critical risks found. For Project Finance proper allocation of risks among the stakeholders is crucial to make the projects bankable. Findings from this study indicate no risk should be neglected and relative importance of risks is critical in allocating risks among stakeholders. This study highlights assessment and the use of RII in the process of allocation and management of risks in infrastructure projects in general and hydropower in particular.

KEYWORDS

Hydropower, Project Finance, Public-Private Partnership, Management, Risk

INTRODUCTION

Everyone has intuitive understanding of risks as uncertainty about the outcome. In business, probability of occurring an event that may have adverse impact is a risk. Risks are imperative and interwoven as the very integral part of any business. General approach in managing risks is identification, quantification and control. In any investment decision, risk taking behaviour of an investor can be explained by behavioural approach based theories including psychological factor (Almansour & Arabyat, 2017). Specific risk factors associated with the projects play significant role in an infrastructure project investment decision.

Development of energy infrastructure opens the way for overall economic development. Hydropower is the sole internal source of electricity for Nepal. Since the government opened up the hydropower for private sector, entrepreneurs have emerged as Independent Power Producers (IPPs). There are good numbers of IPPs in various stages of project development. Information as of mid-July 2020 there are 98 IPPs in operation with 686,168 kW installed capacity, 131 IPPs with 3,157,192 kW of installed capacity under construction having financial closure and 112 IPPs with 2,124,774 kW of installed capacity under construction without having financial closure (Nepal Electricity Authority [NEA], 2020). Generally, issues pertaining to cost and time overrun, construction delays and post operation obstacles are emerging significantly in hydropower projects and posed risks to the hydropower sector.

Energy infrastructure financing is a cornerstone to open the way for all other infrastructure development. Due to growing diversity in the activities of the governments and inability of government to remain as the sole supplier of fund for infrastructure projects, other various modes of the financing for infrastructure development has been practised around the world. Corporate finance or balance sheet financing, PPP financing and project finance or off-balance sheet finance are among the popular financing mechanisms. Hydropower projects generally utilize PPP model because the use of water and land required for the hydropower infrastructure is attached with the sovereign right. Such project by the private sector can be initiated under partnership with public sector. In addition, in the context of developing countries, governments are formulating policy to attract private participation in infrastructure development. Participation of private sector in infrastructure involves financing, development and implementation of project to create infrastructure that produces public goods and services.

Previous studies showed without proper management of risk hydropower projects face problems including cost overrun and time overrun causing failure to fulfil the predetermined financial target leading to complete failure of the project. Uncertainty involved in the method of financing makes the infrastructure project risky (Merna, & Njiru, 2010). Thus the success of the projects rests upon the careful analysis of all of the risks that the project will bear during the economic life of the project (Gatti, 2008). Project Finance risks can broadly be classified into commercial, macro-economic and political risks (Yescombe, 2002). Risks incurred in infrastructure development of any kind in four categories including (i) technical (ii) operational (iii) financial and (iv) commercial (Goldsmith, 1992). Risk factors are of the feature commonly applicable in all projects irrespective of implementation modality but some of the risk factors are more critical in case of specific implementation modality.

In recognition of the importance to manage risks in hydropower projects, the objective of this study is to determine the risk structure of hydropower project with specific reference to project finance in PPP model. Considering all of the above views, hydropower project finance related risks are classified into: (i) hydropower specific risk, (ii) project finance specific risk, (iii) hydropower project financing risk and (iv) country specific risks associated with project financing of hydropower projects.

LITERATURE REVIEW

Hydropower Specific Risks

Most of the hydropower specific risks exist irrespective of the implementation modality i.e. government projects, private corporate finance model project and PPP-Project Finance model projects. Development

of any infrastructure including hydropower project broadly includes technical risks, operational risks, financial risks and commercial risks. Technical risks basically cover risks of malfunction and of unduly rapid deterioration of equipment and facilities as well as risk of unduly early obsolescence due to advancement in technology. Operational risks include risks of unexpected changes in design parameter, unexpected change in hydrology and physical condition of project site and response of power market. Financial risks include risk of overrun in cost and time, risk of unpredictable changes in costs and revenues during the life of the infrastructure assets and currency movements and inflations. Commercial risk is basically the risk of failure to meet the predetermined financial target (Goldsmith, 1992). Since hydropower is a very capital intensive project meeting predetermined financial target is critical.

Long gestation period, site specific and huge capital investments are the unique features of hydropower projects which expose them to various types of technological, financial, political and legal risks. Failure to manage these risks may lead to delays, cost overrun and in extreme situation the failure of the project. Thus irrespective of the modality of the project implementation, comprehensive risk management steps as discussed by Shaktawat and Vadhera (2020) are needed for sustainable development.

Hydropower is considered as renewable clean energy but rivers and connected ecosystem have impact on hydropower production. Many of Nepal's hydropower plants are installed in fragile river basin and therefore are prone to landslides, floods like calamities, snow, glacier melting, and glacier lake outburst. Fragile mountain ecosystem and climate change situation is making the calculated energy of the project unreliable (Dixit, 2019). Nepal's topography offered Run-of-River (ROR) projects which have more risks of landslides, flooding and flash flooding (Bhatt, 2017), giving threats to project sustainability. Stakeholders need to be assured with critical assessment of such risk and appropriate risk management models.

Project Finance Specific Risks

Project Finance is affected by several factors like lack of a stable regulatory, legal and contractual framework and well-coordinated effort, changed investment climate, liquidity crisis, political turmoil, uncertainty in exchange rates, inability of utilities and consumers to pay market-based tariffs, requirement of non-power benefits not bringing any financial benefits to the privately developed projects. Summing up the impact, variety of factors like technical, financial-economic, social, political-legal, and social-environmental risks are significant over the effectiveness of the PPP-Project Finance. These risks are very critical not only from the viewpoint of successful project implementation but from the view of sustainability of project created infrastructure and promotion and ensuring sustainability of investment environment in infrastructure sector including hydropower.

In the context of highly distinguishing and illiquid nature investment in infrastructure composite analysis, allocation and mitigation of risks are involved. From the perspective of an investor, a careful analysis of all the risks which the project is bound to bear during the economic life of the project created infrastructure asset is necessary while determining the acceptable compensation against such risks (Organization for Economic Cooperation and Development [OECD], 2015) in a hydropower project with PPP-Project Finance arrangement.

In Project financing, risk analysis needs consideration of different perspective and the evaluation is complex. Different types of risks involved in Project Finance including technical, financial, regulatory,

political, environmental, construction, revenue, operating and Force Majeure (Grimsey & Lewis, 2002). At the inception, credit risks tend to be high and to diminish over the life of the project under a Project Finance arrangement (Sorge, 2004). Therefore, identification, assessment and adequate management plan for such risks at the very inception of the project implementation are crucial. Credit risks assessment is difficult while financing and project liabilities are kept off-balance sheet. Important advantage of infrastructure financing is that it provides off-balance sheet grantor and shifts some of the risks from sponsors to lenders (Dong et al., 2012). Therefore, how the sponsors and lenders have agreed will have significant effect on the project when such risks occur.

It is possible in Build-Operate-Transfer (BOT) PPP arrangement that the project, project sponsors and the financer to be from different countries, which brings host of cross border risks. In such cases, an intelligent allocation of risk is prerequisite for project success (Kumaraswamy & Zhang, 2001). Therefore, while discussing on the risk of project finance in a context of particular country, the matters related with political, legal, macro economical, banking, taxation, foreign investment and country policies on specific development sector is very crucial to consider.

Hydropower Project Financing Risks

Under this category of risks, all of the hydropower specific risks like technical risks, operational risks, financial risks and commercial risks may have serious influence on the decision of sponsors as well as other stakeholders' decision about go/no-go decision on Project Finance arrangement for a particular hydropower project. Generally, hydropower related specific risks like malfunction and unduly rapid deterioration of equipment and facilities, risk of unduly early obsolescence due to advancement in technology, unexpected changes in design parameter, unexpected change in hydrology, physical condition of project site and power market response are very crucial in a project finance arrangement. Similarly, risk of overrun in cost and time, risk of unpredictable changes in costs and revenues during the life of the infrastructure assets and currency movements, inflations and commercial risks are further critical in project finance that seriously influences the decisions.

There may be situation of excessive water and a situation of spill over caused by rainfall, glacial lake outburst flood, extreme weather events or upstream landslides. Different types of upstream development activity also may cause inadequate or excessive water situation. Hydrology is one of the major risks in the context of hydropower projects. It is generally seen as the risk situation with insufficient water in the source of the rivers or infrastructure including dam to generate the expected level of electricity. In PPP hydropower projects, the developers certainly prefer to shift hydrological risk to off-taker under a Power Purchase Agreement (PPA). In some cases, developer will accept protection from such risk for specified period like PPA period (Blomfield & Plummer, 2014). So it is very critical to see how the hydrological risks have been assessed and managed with proper allocation between the parties of PPP-Project Finance.

Country Specific Risks including Political and Legal Risks in Project Finance

The political and legal risks are seen critically from the viewpoint of project success or failure and very critical for private sector friendly investment environment. Consideration of such important risk factors is generally critical for international and domestic investors as well. International investors are more

concerned with the political and legal risks in the country risk portfolio as they may be in different location from the project.

Hydropower development in developing countries are affected by several factors like (i) lack of a stable regulatory, legal and contractual framework and well-coordinated effort (ii) changed investment climate liquidity crisis (iii) political turmoil (iv) uncertainty in exchange rates (v) inability of utilities and consumers to pay market-based tariffs and (vi) requirement of non-power benefits (like flood control, aquaculture, recreation, irrigation etc.) not bringing any financial benefits to the privately developed projects (Blomfield & Plummer, 2014). Similarly, there are various factors including (i) technical (ii) financial-economic (iii) social (iv) political & legal, and (v) managerial which have significant impact over the success of PPP (Jasiukevicius, 2018). All of the risk factors have direct or indirect relevance with country specific political and legal frameworks.

Political risk is a generic concept to address the risks of political change and instability having impact on the contract and investment. Political risk encapsulates various aspects including regulatory, legal and credit risks (Charnaud et al., 2016). Political risks, type of bidding, purchase agreement (off-take or supply), implementation agreement, debt security and payment security are taken as the influencing attributes and selected cases of few Asian countries. High level as well as, operational political support, is required to the 'financial close' of the infrastructure project in time (Chowdhury & Charoenngam, 2009). Country specific overall political and legal risks influences even the steps in management of the risks falling under all the categories discussed above. There is critical influence by the interest of all individuals, groups and community in the position of the society, their relations and interrelated roles on the project investment. Therefore, it is critically important to examine the politics behind the project process which are attributable for project success or failure (Pathammavong et al., 2017). Moreover, in international business, the most critical issues is the assessment of the impact of the political risks (Bekaert et al., 2016). This indicates that parties in project finance arrangement including sponsors, financers, contractors and all other stakeholders who may be from different countries seriously consider host country specific political and legal risk factors.

Risks Assessment and Allocation

For Project Finance the project itself should be worthy enough to be treated as the collateral for the project loan or there should be a bankable project. Essentially, the bankable project legally frees the project company and the lender from risks as all the foreseeable risks are allocated to the parties other than the project company and investing banks.

Risk management is crucial in infrastructure project construction. In PPP projects, unilateral allocation of risks is not always possible. Along with proper categorization, risks can be identified by framing a checklist (Bing et al., 2005). Potential risks and their allocation as shown in table 1 below are self-explanatory. It shows the item of sample risks and their best possible allocation which are derived from the review of literature.

Table 1: Risks and Allocation

Risk	Allocation
Cost and Time Overrun	EPC Contractor Fixed Price
Market/Revenue	Off-taker (NEA) under Take of Pay basis
Production	Irrevocable Generation License
Off-taker Default	Government
Natural (force majeure like earthquakes, floods, landslides etc.)	Insurance Company
Currency	Hedging with currency swap contract with counter-party or purchaser and government
Operating	Operation and Maintenance Contractor
Political Force Majeure (like changes in law, nationalization, war, political turmoil etc.)	Government

In PPP projects risks pertaining to site acquisition, legal and policy risks or similar nature risks are allocated to public sector whereas design and construction related risks, operation risks and other similar nature risks are allocated to private sector (Shen et al., 2006). Risks of cost and time overrun are shifted to the contractor by the process of Engineering and Procurement Contract (EPC) with fixed price and time. Likewise, in an energy sector project undertaken by private sector market and/or revenue risk can be assumed by the power off-taker. In case of Nepal, it is the NEA that enters PPA agreement with the IPPs. Production risks can be mitigated through the irrevocable generation license to the IPPs by the government. Likewise, any default by the off-taker and political force majeure risks shall be allocated to public sector. As informed during the interview conducted for this study the risks have been assumed by the government in the Project Development Agreement (PDA) with the developer. Exchange rates and currency related risks can be shared through the hedging arrangement between government, power purchaser and the other counterparties.

If all of the risks are managed contractually, the project becomes bankable and capable of being used itself as collateral of project loan (Neupane, 2017). The success of first two private projects with Foreign Direct Investment (FDI) in Nepal was taken as key path for future endeavours (Dhungel, 2016). But with respect to issues relating PPA in foreign funding projects, it has been noted that NEA, the off taker of the power produced entered PPA with the first two projects in dollar denomination under pressure to have reduced the hours long power cut situation. At the time when NEA itself was running financially vulnerable, these PPA contracts made NEA weaker financially as the trend of Nepalese Rupee decreasing against the US dollar and over the past years rupee continued to be weaker. This made NEA somehow reluctant for dollar denominated PPA. This impacted the IPPs specifically the projects with FDI and foreign investment to encounter mismatch of dollar denominated debt and rupee denominated revenue.

The contract document is the tool for managing the risks (Pawar et al., 2015). The client, contractor and investors of the project have to frame out risk management policy throughout the project life. Appropriate allocation of risks is crucial for successful implementation of PPP project (Chan et al.,

2011). It is very important that both the private and public party of PPP should work for efficient risk allocation process in order to reduce the disputes during the concession period (Alireza et al., 2014). Equitable allocation of risks mitigates the potential unnecessary conflicts and time consuming arbitration processes.

Relative Importance of Index

Literature review shows that Relative Importance Indices (RII) has been mostly applied to assess risk factors in construction projects. In this paper, RII is used to identify the relative importance of risk factors from the viewpoint of overall project implementation. Analysis is based on the survey questions answered by the respondents from IPPs and BFIs. Simple model of RII is found to be as follows:

$$\text{RII} = \frac{5n_5+4n_4+3n_3+2n_2+1n_1}{AxN} \quad \textbf{(1)}$$

Where,

n_5=number of respondents Strongly Agree, n_4=number of respondents Agree, n_3=number of respondents Neutral, n_2=number of respondents Disagree, n_1=number of respondents Strongly Disagree, A= Highest Weight i.e., 5 and N= total number of respondents under the survey

The model has also been expressed as:

$$\text{RII} = \sum_{i=0}^{n} \frac{Wi}{AxN} \quad \textbf{(2)}$$

Where, N is the total number of respondents, A is highest weight and Wi is the total sum of the factors.

Agrawal (2010) used RII analysing relative importance for data collected and used Analytical Hierarchy Process (AHP) after consulting expert in second survey for his study on successful delivery of PPP project. Gündüz et. al., (2013) in their study of quantification of delay factors for construction projects in Turkey used RII. For the analysis, they conducted interview and recorded responses in a five-point scale indicating 1= very low important to 5-very high important. Hossen et.al., (2015) used AHP to analyse severity of risk and frequency of occurrence of risk by RII method in their study of construction delay risk in international nuclear power plant. Husin et al., (2018) used Frequency Index (FI) and Severity Index (SI) similar to RII and AHP in their study of risk assessment of resource factor in affecting project time. Muneeswaran et al., (2020) in their study of schedule delay and risks in Indian construction industry also used RII method.

METHODOLOGY

Project Finance and hydropower specific risks were identified from the review of literature. Descriptive and analytical study design has been applied and cross-sectional data have been collected. The methodology comprised comprehensive review of literature, followed by questionnaire survey and semi-structured interview conducted for the study. The questionnaire formulated in five point Likert scale of 1

denoting strongly disagree, 2 denoting disagree, 3 for neither agree nor disagree, 4 denoting agree and 5 for strongly agree has been used. Respondents of the survey basically consist of IPPs and BFIs.

The responses received have been analysed using the SPSS and MS-Excel. Descriptive statistical results as produced by SPSS have been used to calculate RII. Analysis of RII has been done in MS-Excel with descriptive data produced by SPSS. Altogether 54 respondents participated in the survey among them constitutes persons responding on behalf of IPPs and BFIs.

The respondents consist of Chartered Accountant, Masters of Business Administration, and Masters of Engineering. Responsibilities of the respondents include Chief Executive Officers (CEOs) and Deputy CEOs and Chief Executive Engineers, Company Secretaries, Chief Financial Officers (CFOs) and Project Engineers.

Respondents were asked to give their response in the scale about the risk factors responsible for implementation of hydropower projects in general, and risk factors affecting Project Finance arrangement in particular. Specifically, the risk factors for this study were grouped in four main categories such as (i) hydropower specific risks (ii) project finance specific risks (iii) hydropower project financing risks and, (iv) country specific risks associated with project financing of hydropower projects.

Altogether 43 questions were asked to the respondents. The questionnaire categorised all identified risks in four categories mentioned above. In analysis, the risk factors in individual categories have been handled separately as well as taking all the risk factors together. While analysing all the risks together same risk falling under two or more categories, the one with highest RII score has only been considered. In this study, AHP could not be applied because using AHP needs pairwise comparison of criteria. For AHP computation of pairwise comparison matrix is the basic step. Pairwise comparison as mentioned by Saaty (1990; 1988) is comparing opinion of respondents on one criterion in relation to other criteria and then obtaining the value for inverse comparison. Thus it requires quantification of relative priorities between the criteria. The scope of this study was not to take opinion of respondents on one risk item comparing to another risk. Therefore, pairwise comparison has not been done. Hence, this is the delimitation of the study.

RESULTS AND DISCUSSION

Descriptive Analysis

Data collection procedure adopted for this study produced altogether 54 completed questionnaire consisting 35 from IPPs, 19 from BFIs. The overall response rate is 45% which is good comparing the 20%-30% of norms taken for construction projects (Hwang et al., 2013; Akintoye, 2000) as the respondents are directly from the construction projects or directly involved into construction of the projects. Overall scenario of the response is that among the given five alternative answers respondents have selected 4 (Agreed) option in most of the questions. In some of the variables like construction cost and time overrun the respondents have selected 5 (strongly agreed) or 4 (agreed).

Table 2 shows the descriptive statistics particularly the Mean, Mode and Standard Deviation of the data. As depicted in the table risk of construction cost overrun (mean=4.33) is most critical. Similarly construction time overrun (mean=4.06), changes in foreign currency exchange rate (mean=4.07), hydrological risks (mean=3.94), construction risk including geological risks as well as potential mismatch of foreign exchange in local currency revenue and dollar denominated project loan (mean=3.83) are most critical risks in hydropower projects.

Results of Mode value indicates that majority of the variables reported 4 (Agreed) responses while other variable like risk of construction cost and time overrun has mode value of 5 (Strongly Agreed) indicating these risks as very critical in any infrastructure project. As regards Market/Revenue risk Mode value is 2 (Disagree) indicating that as the IPPs enter into PPA on 'take or pay' basis with the off-taker. Thus, they find no substantial risks of market or revenue. In addition variables like early obsolescence of equipment and facilities as well as potential conflict with another infrastructure project, the Mode value is 2 indicating no such risks substantially. All other variables resulted with 4 or 5 Mode values.

Looking at the results pertaining to standard deviation (Std. Dev.), factors like risk of discontinuation of off-take agreements (1.31), provisions of law relating to FDI and technology transfer (1.27) provisions of law relating to taxation (1.25), policies relating to hydropower development (1.23). All of the values of standard deviation are tend to be closer to the mean, not a wider spread (Table 2).

Table 2: Descriptive Statistics

Variables	Mean	Mode	Std. Dev.
Project Finance	3.78	4	1.16
Market/Revenue risks	3.04	2	1.26
Operating risks	3.31	4	1.13
Financial risks	3.50	4	1.18
Political risks	3.70	4	1.09
Legal risks	3.50	4	1.13
Environmental risks	3.65	4	1.03
Construction risk including geological risks	3.83	4	1.16
Hydrological risks	3.94	4	1.02
Terrestrial risks	3.44	4	0.96
Social risks	3.54	4	1.04
Political risks	3.57	4	1.18
Credit strength of counter party	3.50	4	0.99
Evolving and untested regulatory and legal framework	3.54	4	0.88
Concern relating to global transparency	3.30	4	1.00
Potential foreign risks relating to mismatch of project revenue and loan	3.83	4	1.13
Event of default by off-taker to pay for supplied energy	3.06	4	1.11
Concern relating to consistency in policy	3.46	4	1.06
Risk of malfunction of equipment and facilities	3.06	4	1.22
Risk of unduly rapid deterioration of equipment and facilities	3.07	4	0.95
Risk of unduly early obsolescence due to technical advancement	2.67	2	1.13
Risk of unexpected changes in original design parameter	3.15	4	1.17
Risk of unexpected changes in hydrology	3.56	4	1.08
Physical condition of the project site	3.46	4	1.08
Power market response	3.15	4	1.14
Risk of construction cost overrun	4.33	5	0.85
Risk of construct ruction time overrun	4.06	5	1.17

Inflation	3.83	4	1.11
Changes in foreign currency exchange rate	4.07	4	0.93
Risk of failure to meet predetermined financial targets	3.87	4	1.05
Unpredictable changes in costs throughout the life time of assets	3.22	4	1.09
Potential conflict with another infrastructure projects	2.63	2	1.14
Political turmoil	3.39	4	1.12
Highly volatile political environment	3.41	4	1.19
Economic policy adopted by the government	3.13	4	1.05
Legal provisions	3.22	4	1.09
Provisions relating to companies	3.09	3	1.10
Provisions of laws relating to taxation	3.15	4	1.25
Provisions of law relating to foreign investment and technology transfer	3.28	4	1.27
Policies relating to PPP	3.09	4	1.15
Policies relating to non-recourse finance	3.15	4	1.12
Policies relating to BFIs	3.26	4	1.17
Policies relating to hydropower development	3.17	4	1.22
Risk of discontinuation of off-take agreement (PPA)	3.22	4	1.31
Risk relating unionism	3.35	4	1.22

Analysis of Relative Importance Indices

Review of literature reveals various methods of ranking risks and critical success factors in project implementation. Hwang et al., (2013) used mean value to rank the critical success factor on their study employing 5-point Likert scale. Relative Importance Indices were used in various previous studies cited above. This study used RII to rank the hydropower sector risks based on the data collected with 5-point Likert scale. The analysis consists of separate analysis of the risks falling under each category.

In the context of infrastructure projects, risks can be seen from two broad perspectives, first, the common risk factors applicable in all the infrastructure projects irrespective of the sector and the second, sector specific risk factors. Tables from 3 to 6 below show the results according to the relative importance of the risks and the respective rank of importance ascertained based on the RII value. The importance column throughout the tables below indicates 1 for first highest value of RII, 2 for the second highest value of RII and so on.

Hydropower Specific Risks

These risks are attached with every hydropower projects irrespective of project implementation modality. For example, since the hydropower is to use the water and availability of water depends upon the hydrology. Various types of environmental challenges like global warming, climate change and other environmental phenomena have direct impact on hydrology. However, the impact of these environmental misbalances can be severe or lower based upon the geography. So far as Nepal is concerned the source of water to its river systems are the high Himalayas. With the impact of global warming, the huge deposits of snow have been melting fast causing floods, landslides and other risks to hydropower infrastructures in wet season whereas the volume of water in the dry and cold winter season is such low that the

hydropower companies are not able to supply the committed energy. Hydropower specific risks analysed using RII are as shown Table 3.

Table 3: RII of Hydropower Specific Risks

Risk Factor	$1n_1$	$2n_2$	$3n_3$	$4n_4$	$5n_5$	Sum	A*N	RII	I
Market/Revenue risks	5	38	18	68	35	164	270	0.61	10
Operating risks	2	32	15	100	30	179	270	0.66	9
Financial risks	3	22	18	96	50	189	270	0.70	8
Political risks	3	12	18	112	55	200	270	0.74	3
Legal risks	4	10	39	92	45	190	270	0.70	6
Environmental risks	1	16	33	92	55	197	270	0.73	4
Construction & geological risks	3	12	15	92	85	207	270	0.77	2
Hydrological risks	2	8	15	108	80	213	270	0.79	1
Terrestrial risks	2	14	45	100	25	186	270	0.69	7
Social risks	2	18	24	112	35	191	270	0.71	5

Note: RII= Relative Importance Index, I= Rank of Importance

As depicted in Table 3, respondents perceived hydrological risks as the most important, followed by construction risks including geological risks, political risks and environmental risks followed by social risks and so on. Due to geographical location of Nepal hydrological, geological, environmental and terrestrial risks are significant factors affecting Nepal's hydropower projects. The result indicates risk of hydrology as mentioned by Bhatt (2017) and Dixit (2019) is very pertinent to the hydropower projects in Nepal. The result with respect to construction and geological risks indicates this has direct impact on the cost and time overrun due to variations in budgeted cost and planned project construction time discussed in following paragraphs.

Project Finance Specific Risks

Project finance has long history of its development in developed countries. In case of developing countries as well this model of infrastructure finance is getting popularity. This view is supported in several previous studies. But moving forward with this modality some of the risks encountering the infrastructure project have been found to be unique with the context of the host country. Risks pertaining to project finance and their relative importance are depicted in table below.

Table4: RII of Project Finance Specific Risks

Risk Factor	$1n_1$	$2n_2$	$3n_3$	$4n_4$	$5n_5$	Sum	A*N	RII	I
Political risks	3	20	15	100	55	193	270	0.72	2
Credit strength of counter party	3	10	39	112	25	189	270	0.70	4
EURLF	0	20	27	124	20	191	270	0.71	3
Concern relating to global transparency	2	24	33	104	15	178	270	0.66	6
Exchange Mismatch in Revenue & Loan	3	12	9	108	75	207	270	0.77	1
Default by power off-taker	5	26	39	80	15	165	270	0.61	7
Consistency in policy	3	18	21	120	25	187	270	0.69	5

Note: RII = Relative Importance Index, I = Rank of Importance, EURLF = Evolving and Untested Regulatory and Legal Framework

As shown in Table 4, risk arising due to exchange mismatch of revenue accrued in local currency and obligation of repayment of dollar denominated foreign debt amount has obtained highest importance with highest RII value in this category of risks. This phenomenon is highly related with projects not only with the private project with FDI but also to the government sponsored projects utilizing loan from foreign institutional investors including various bilateral and multilateral development organizations. The important issue in hydropower sector in Nepal is mismatch of Nepali rupee revenue against the dollar denominated project loan. Hedging is an important tool in managing such currency and price related risk (Nadirah et al., (2014). Hedging has been discussed as the important measure for mitigating these risks and the government authorities are working to resolve the issue. The risk of exchange mismatch is followed by political risk with second highest RII value. This implies fast changing political environment and governance in Nepal is highly risky factor for PPP project finance in infrastructure development. This is also supported by RII value of the factors like evolving and untested regulatory and legal framework, credit strength of counterparty including the host government and consistency in policy. These risks have respectively occupied third, fourth and fifth rank of importance.

Hydropower Project Finance Risks

This category of risk is the blend of common hydropower sector specific risks and projects finance specific risks which are critical to consider in a hydropower projects with project finance modality. Table 5 depicts the results of the separate analysis of hydropower project specific risks.

Table 5: RII of Hydropower Project Financing Risks

Risk Factor	$1n_1$	$2n_2$	$3n_3$	$4n_4$	$5n_5$	Sum	A*N	RII	I
Malfunction of equipment and facilities	7	26	24	88	20	165	270	0.61	11
URDEF	1	34	45	76	10	166	270	0.62	10
UEOTA	6	48	30	40	20	144	270	0.53	12
UCODP	6	22	30	92	20	170	270	0.63	9
Unexpected changes in hydrology	3	14	24	112	40	193	270	0.72	6
Physical condition of the project site	3	18	24	112	30	187	270	0.69	7
Power market response	4	30	24	92	20	170	270	0.63	9
Construction cost overrun	1	4	3	96	130	234	270	0.87	1
Construction time overrun	3	10	6	80	120	219	270	0.81	3
Inflation	5	2	15	120	65	207	270	0.77	4
Changes in foreign currency exchange rate	1	6	18	100	95	220	270	0.82	2
FPFT	3	6	18	112	70	209	270	0.77	5
UCCL	3	24	45	72	30	174	270	0.64	8
PCIP	10	32	42	48	10	142	270	0.53	13

Note: RII = Relative Importance Index, I = Rank of Importance, URDEF = Unduly Rapid Deterioration of Equipment and Facilities, UEOTA = Unduly Early Obsolescence due to Technical Advancement, UCODP = Unexpected Changes in Original Design Parameter, FPFT = Failure to meet Predetermined Financial Target, UCCL = Unexpected Changes in Cost during life time of Assets, PCIP = Potential Conflict with another Infrastructure Project.

In this category, construction cost overrun and changes in foreign currency exchange rate followed by construction time overrun are first, second and third rank of importance respectively. Inflation is commonly applicable risk irrespective of the modality whether the project is implemented by government, government undertaking or company or PPP-Project Finance model or even in the corporate finance. In case of PPP-Project Finance, it is more critical. Inflation has been perceived as highly important after the cost and time overrun along with foreign exchange volatility.

Construction cost overrun seems to be the most critical risk in hydropower projects. This is the risk which is highly pertinent to the construction project of infrastructure sector including hydropower. As per the above result this risk has been followed by changes in foreign currency exchange rates and risks of construction time overrun being ranked at 2nd and 3rd position. Inflation is in the 4th rank while the risk of failure to meet the predetermined financial target is at 5th rank. These results clearly indicate that in hydropower project finance cost, time and currency related problems are highly significant factors for project success.

Country Specific Risks Associated with Project Finance in Hydropower Projects

As the momentum in economy increased, the response of political and legal system of the host country also increased. In Nepal, hydropower infrastructure has been influenced and impacted by the political and legal system of the country. As the government adopted policy of attracting private investment to utilize the available water resource to generate electric power domestic as well as international hydropower private entrepreneurs entered into Nepal power market. This gave birth to various challenges to the entrepreneurs as well as the government.

In Nepal, the Electricity Act, 1992, the Foreign Investment and Technology Transfer Act, 1992 and the Industrial Enterprise Act, 1992 protects companies with foreign investment as well as all industries and power project against the nationalization and expropriation (Souche et al., 2016). Political and legal risks are such item of risks which can be attributable to failure of any project.

FDI is an important pillar of industrialization and plays an important role in bolstering economic growth (Wen et al., 2013). For infrastructure projects and more importantly PPP projects where FDI as well has been expected as the important source of finance, political and legal risks are critically evaluated not only by the international investors but by the domestic investors as well. There are number of determinants of FDI inflow into countries in a region (Young et al., 2016) which can play role of risk factors. These are the risks to consider for the sustainable investment environment from not only the viewpoint of cross border investment but equally from the domestic investment as well.

Political and legal risks with respect to infrastructure project in general and hydropower projects in particular have also been analysed in this study. The results of RII on country specific risks are presented in Table 6 below.

Table 6: RII of Country Specific Risks Project Finance in Hydropower Projects

Risk Factor	$1n_1$	$2n_2$	$3n_3$	$4n_4$	$5n_5$	Sum	A*N	RII	I
Political turmoil	4	10	45	80	50	189	270	0.70	1
Volatile political environment	4	18	36	76	50	184	270	0.68	2
Economic policy	5	20	39	100	5	169	270	0.63	7
Laws relating to companies	4	26	48	64	25	167	270	0.62	9
Laws relating to taxation	5	30	27	68	40	170	270	0.63	6
LFDI	7	26	15	84	40	172	270	0.64	4
PPP Policy	5	28	30	80	25	168	270	0.62	8
Non-recourse financing Policy	5	26	24	96	20	171	270	0.63	5
Central Bank policy on BFIs	5	20	27	100	25	177	270	0.65	3
Policies relating to hydropower development	5	32	18	88	25	168	270	0.62	8
Discontinuation of PPA	11	24	18	68	40	161	270	0.60	10
Unionism	5	22	33	80	35	175	270	0.65	4

Note: RII = Relative Importance Index, I = Rank of Importance, LFDI = Laws relating to foreign investment and technology transfer

Political turmoil and highly volatile political environment have ranked first and second importance respectively followed by central bank's policies on BFIs as third rank of importance. The results show that unionism is still perceived by the respondents as the fourth highest risk factor in hydropower projects. The critical issue regarding policies relating to non-recourse financing comes as fifth important factor which is followed by the economic policy adopted by the government as seventh important factor. While the government is pleading the suitability of PPP model in hydropower and promise to ensure the security of the investment and return on investment the private entrepreneurs are still reluctant to fully trust the concern relating to consistency in the policy of the government to remain intact over the life of the investment. As the infrastructure projects involves various types of social issues like use of water, land and forest, rehabilitation and resettlement issues, lost traditional income source of the local inhabitants as well as environmental issues are very critical and may provide critical political turmoil. The risk of unionism has been a very critical issue in all sectors of Nepal and also perceived as

important by the respondents. Other important risk factors like PPP policy, policies relating to BFIs, taxations, provisions relating to companies etc. have also resulted with significant perception by the respondents.

In addition to the category-wise analysis overall analysis of RII taking all of the variables under the four risks categories together has also been done. Figure 2 below is the diagrammatic presentation of the overall results of all the risk variables discussed above.

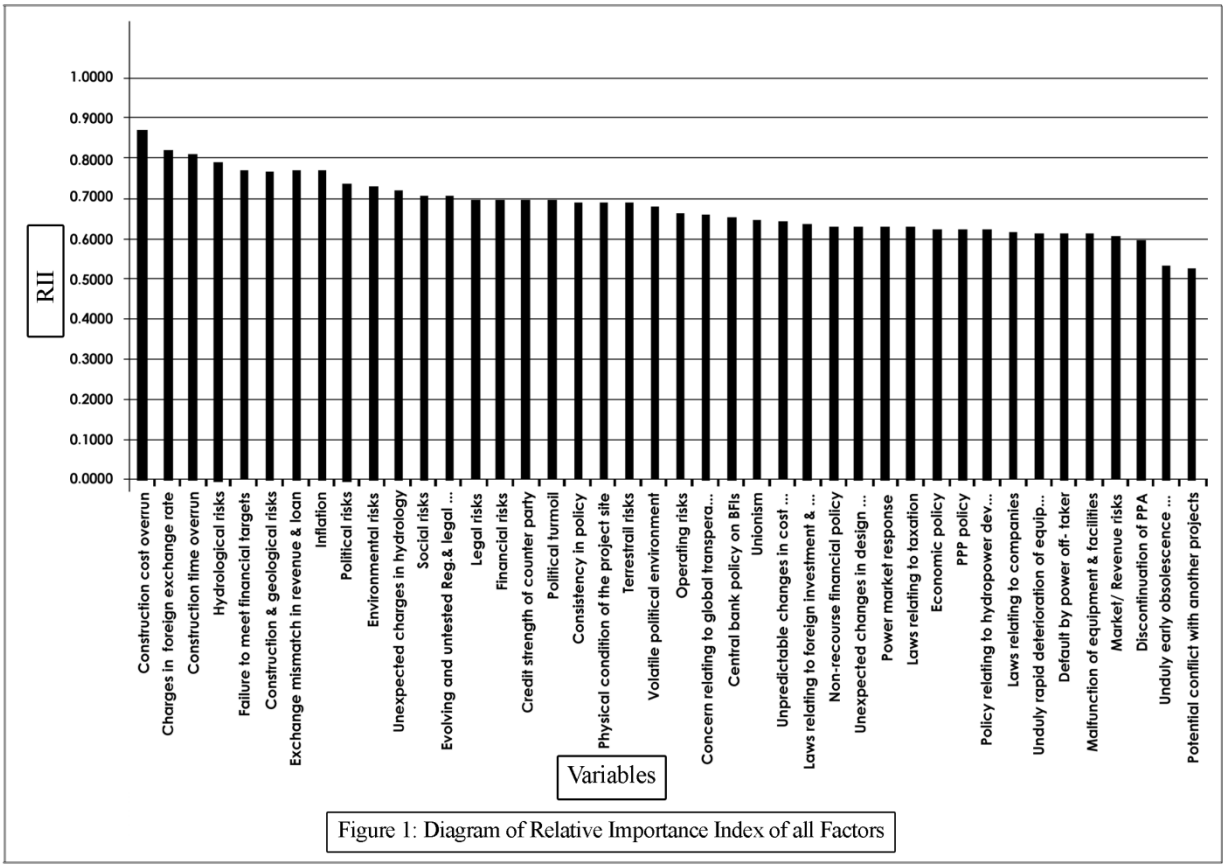

Figure 1: Diagram of Relative Importance Index of all Factors

There were altogether 43 risk factors taken for the study. The figure (Figure 1) shows RII diagram of 42 factors, as the questions pertaining to political risk was asked in hydropower specific risks category and project finance specific risk category, but only one answer with highest score has been considered.

Overall results show construction cost overrun, changes in foreign exchange rate and construction time overrun are the most critical risk factors occupying the first, second and third position respectively irrespective of implementation modality. All of these three factors are RII value more than 0.8. There seems strong relation between changes in exchange rates and construction costs as all the hydropower projects have to import critical machinery and equipment involving foreign currency transaction while Nepali rupee is getting weaker continuously. Similarly, the results show construction time overrun risk occupying third position. Hydrological risk is in the fourth positions. Failure to meet predetermined financial target occupies fifth position. In fact, risk of failure to meet predetermined financial target is the product of various types of other risks for example changes in hydrology with reduced water volume

impacting failure to supply contracted energy as per the PPA in PPP projects. Construction and geological risks, risks of exchange rate mismatch between local currency denominated revenue and dollar denominated project loan as well as inflation has equal RII value. All of these three factors occupied sixth position. Political risks seem to be at seventh position. Nepal had gone through the vicious political turmoil in the past and political situation in the newly established federal democratic system will take time to stabilize and potential political turmoil in future may jeopardize the development initiatives. Although the country has a long history of constitutional development, the recent constitution adopting federal democratic political system have caused critical changes in the existing laws. Eventually various new regulatory and legal frameworks have evolved and these frameworks need time to be proved as appropriate. In the past Nepal's internal politics revolved around the hydropower projects. Withdrawal of the World Bank from Arun III hydro project and changes in internal and external power dynamism with respect to projects like West Seti, Budhi Gandaki, Upper Karnali and many other projects are apparent evidence of power politics in Nepal and the region. Similarly, delay in implementation of Pancheswor Multipurpose Project is the strong example of conflict in regional hydropower politics which has brought many ups and downs in the aspirations of the Nepali people. Politics should be delinked from the utilization of hydropower and energy should be treated as a market commodity.

CONCLUSIONS

The development of hydropower infrastructure in Nepal is important to fulfil the internal energy demand. Additionally, Nepal can fully utilize its high potential of water resources to trade hydropower as a market commodity. In view of the limited public sector resources available for infrastructure development, attracting private participation in developing hydropower is almost seen as unanimous phenomena in Nepal's economic development. Project Finance can be arranged if the project itself is bankable. Projects are bankable only when it is free from the associated risk through proper allocation of the risks between the stakeholders.

The analysis indicated that among hydropower specific risks hydrological risks has high score which indicated high threats to project sustainability. This has been followed by construction risks including geological risk, political risks, environmental, and social risks. Among the risks identified under Project Finance related specific risks potential foreign exchange risks related to mismatch of dollar denominated project loan and local currency revenue has high importance. This is followed again by political risks, evolving and untested legal and regulatory framework and credit strength of counterparty including host government. Similarly, among the risks relating to project finance in hydropower sector risks of construction cost overrun and changes in foreign exchange followed by construction time overrun and inflation has been perceived by the respondents as highly important. In case of country specific risks, the respondents perceived political turmoil, highly volatile political environment, policies relating to BFIs and policies pertaining to foreign investment and technology transfer as the riskiest factors.

This study identified risks critical for hydropower sector from review of literature and analysed on the basis of responses under the survey conducted. No risk can be left unattended, unallocated or unmanaged. The study shows to materialize the objective of utilizing Nepal's abundant hydropower resource, projects are to be bankable. Bankability of projects can be ensured by proper allocation and management of associated risks. Government and its specified agencies need to proactively initiate to assume the related risks keeping in mind the importance of utilization of untapped vast water resource

potential. Similarly, sponsors need to appraise the projects properly based on in-depth and rigorous studies of feasibility of the projects.

Empirical evidences on relative importance of hydropower related risks in Nepal have been provided based upon the opinion of the respondents basically from IPPs and BFIs. RII rates the importance given by the respondents to a particular statement and not the ranking between the statements. Thus, this paper only highlights relative importance of common risk factors, showing weights of individual risk factors, but not comparing one statement with the other. For ranking between the statements and severity of its impacts in a specific project, methods like Analytical Hierarchy Process (AHP) as per Saaty (1990; 1988) can be applied. Detail opinion of the respondents about the risks, its severity and its assessment in a particular project to have robust results in that specific project case can be obtained by applying AHP. This study attempted to find the relative importance of the risks in general in the hydropower sector of Nepal on the basis of the survey responses. Therefore, objective and robust analysis with AHP of risks pertaining to any specific hydropower project has been left for future studies.

Management of risks with proper allocation among the stakeholders ensures bankability of hydropower projects. Stakeholders may consider the indices discussed in this paper in management of risks in infrastructure project finance including hydropower. Identification, assessment and allocation of risks discussed in this paper can be replicated in the field of any infrastructure project to ensure better management of associated risks.

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