FACTOR INFLUENCING THE FINANCIAL PERFORMANCE OF SMALL HYDROPOWER PROJECTS IN NEPAL

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By

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CERTIFICATION OF AUTHORSHIP

I hereby corroborate that I have researched and submitted the final draft of dissertation entitled "**FACTOR INFLUENCING THE FINANCIAL PERFORMANCE OF SMALL HYDROPOWER PROJECTS IN NEPAL**". The work of this dissertation has not been submitted previously for the purpose of conferral of any degrees nor it has been proposed and presented as part of requirements for any other academic purposes.

The assistance and cooperation that I have received during this research work has been acknowledged. In addition, I declare that all information sources and literature used are cited in the reference section of the dissertation.

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REPORT OF RESEARCH COMMITTEE

Mrs. Binita Basnet has defended research proposal entitled **"FACTOR INFLUENCING THE FINANCIAL PERFORMANCE OF SMALL HYDROPOWER PROJECTS IN NEPAL"** successfully. The research committee has registered the dissertation for further progress. It is recommended to carry out the work as per suggestions and guidance of supervisor Asst. Prof. Durga Datt Pathak and submit the thesis for evaluation and viva voce examination.

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APPROVAL SHEET

We have examined the dissertation entitled "**FACTOR INFLUENCING THE FINANCIAL PERFORMANCE OF SMALL HYDROPOWER PROJECTS IN NEPAL"** presented by Mrs. Binita Basnet for the degree of Master of Business Studies. We hereby certify that the dissertation is acceptable for the award of degree.

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ABBREVIATIONS

ANOVA	:	Analysis of Variances
CLI	:	Client Related Factor
CNR	:	Contractual Relationship
CNS	:	Consultant Related Factor
DOI	:	Diffusion of Innovation
EXT	:	External Environment
FPR	:	Financial Performance
KW	:	Kilowatt
MHP	:	Micro-Hydropower Plants
N	:	Number of Responses
PPP	:	Public-Private Partnership
PRO	:	Project Related Factor
S.D.	:	Standard Deviation
SHP	:	Small Hydropower Projects
VIF	:	Variance Inflation Factor
WECS	:	Water and Energy Commission Secretariat

ABSTRACT

This study examines the financial performance of small hydropower projects in Nepal, focusing on the impact of various factors such as client-related, consultant-related, project-related, external environment, and contractual relationships. The objective is to identify and analyze these factors to provide insights into the financial viability and profitability of such projects, particularly given Nepal's reliance on hydropower and the global push for sustainable energy.

The research design combines descriptive statistics and causal-comparative analysis to evaluate the impact of the aforementioned factors on financial performance. The population includes the workforce of 53 small hydropower projects in Nepal, with a sample size of 200 respondents from various stakeholders. Data collection was conducted using a structured questionnaire survey with a Likert scale to gather reliable quantitative data from the hydropower and electricity sector stakeholders. The data was meticulously analyzed using Microsoft Excel and SPSS, employing statistical tools such as descriptive statistics, correlation analysis, and multivariate regression modeling. The research framework established relationships between the dependent variable, financial performance, and independent variables including project-related factors, contractual relationships, client-related factors, consultant-related factors, and the external environment.

The results indicate that client-related and consultant-related factors have a strong and significant positive impact on financial performance, underscoring their crucial role in enhancing financial outcomes. Conversely, project-related factors, the external environment, and contractual relationships show weaker and statistically insignificant impacts, suggesting they are less influential in determining financial performance.

This study has both practical and theoretical implications. Practically, it highlights the importance of client-related and consultant-related factors in boosting financial performance. Theoretically, it reinforces the significance of these factors in project management and financial performance frameworks. It is recommended that project stakeholders prioritize improvements in client and consultant-related aspects to enhance financial outcomes. Improved communication, expertise, and collaboration between clients and consultants can lead to more successful project execution.

Keywords: *Small hydropower projects, Financial performance, Client-related factors, Consultant-related factors.*

CHAPTER I
INTRODUCTION

1.1 Background of the Study

Nepal relies exclusively on hydropower as its primary domestic source of electricity. The introduction of the government's policy promoting private involvement in the hydropower sector has led to a notable presence of Independent Power Producers (IPPs). These producers have become prominent participants in infrastructure development through the Public-Private Partnership (PPP) model. This strategic collaboration marks a shift in the dynamics of the hydropower industry, with private entities playing a substantial role in the generation and distribution of electricity in Nepal (Nepal et al., 2021).

The rapid increase in worldwide energy demand, driven by economic and population growth, especially in developing countries, presents both promising opportunities for economic progress and significant challenges such as energy security and climate change. As the economy expands, there is a growing need for more energy resources to meet the needs of an expanding consumer base, which relies heavily on fossil fuels. This reliance exacerbates greenhouse gas emissions, particularly carbon dioxide, leading to the alarming effects of global warming. Additionally, a considerable portion of the global population still lacks access to electricity, highlighting the urgent need to transform energy generation, transmission, distribution, and consumption practices. This transformation is crucial for achieving a sustainable energy future, improving living standards, ensuring equitable access to modern energy services, enhancing energy efficiency, protecting the environment, and strengthening global energy supply reliability (Kishore et al., 2021).

The effective management of risks is crucial in the dynamic landscape of business, where uncertainty about outcomes prevails. In the context of investments, particularly in infrastructure projects, understanding and mitigating risks are paramount. The general approach to risk management involves the identification, quantification, and control of potential risks. Investors' risk-taking behavior, integral to investment decision-making, is often explained by behavioral theories incorporating psychological factors. In the realm of energy infrastructure development, which is foundational for overall economic growth, the emergence of Independent Power Producers (IPPs) in Nepal signifies a shift towards private sector involvement in hydropower projects. Despite the significant progress with

98 IPPs in operation, issues such as cost and time overruns, construction delays, and post-operation challenges pose substantial risks to the sector (Nepal et al., 2021).

The primary aim of hydropower is to harness water's energy for the generation of hydroelectricity, serving as a clean and renewable energy source. Beyond electricity generation, hydropower projects have diverse objectives, including enhancing energy security by reducing reliance on fossil fuels, contributing to sustainable development through lowered greenhouse gas emissions, promoting regional development via job creation and infrastructure projects, and aiding water resource management by regulating water flows and supporting irrigation capabilities (Smith et al., 2007).

The evaluation of the financial performance of small hydropower projects focuses on assessing their economic viability and profitability. This assessment involves scrutinizing various financial indicators to gauge the project's success in generating returns on investment and ensuring sustainable financial outcomes. Key metrics such as return on investment (ROI), net present value (NPV), internal rate of return (IRR), payback period, and cash flow analysis are employed to measure the financial performance. These metrics offer insights into the project's profitability, financial sustainability, and the duration required to recover the initial investment. Additionally, factors like capital costs, operating expenses, revenue streams, financial management practices, and adherence to regulatory frameworks are considered when evaluating the financial performance of small hydropower projects. By thoroughly analyzing these financial aspects, stakeholders can make well-informed decisions regarding the development, operation, and investment in small hydropower projects (Harrison et al., 2003).

Small hydropower projects play a vital role in addressing the growing demand for sustainable energy worldwide, offering a more environmentally friendly alternative to larger hydroelectric plants. The financial performance of these smaller projects is a critical concern for stakeholders, influencing their economic viability and long-term success (Walczak, 2018). Nepal's first hydroelectric venture, the Pharping Hydropower Project, dates back to 1911, marking the inception of performance challenges that persist across the majority of projects, with only a few exceptions by independent power producers (Mishra et al., 2018). Poor project performance impacts clients through revenue loss, reduced productivity, and limited facility utilization, while contractors face challenges such as increased costs and prolonged work durations (Haseeb et al., 2019). Researchers anticipate a growing interest in small hydropower, driven by its cost-

effectiveness as a renewable energy source and government initiatives to expand distributed generation (Bøckman et al., 2008). The study's overarching goal is to evaluate the factors influencing the performance, delays, cost overruns, and profitability of small hydropower projects.

Abundant water resources of Nepal present a significant opportunity for hydropower production, with an estimated potential of 83,000 MW. However, economic constraints limit feasible development to around 42 GW of capacity. Despite this potential, Nepal's energy sector remains heavily reliant on traditional sources, with fuelwood constituting over three-quarters of total consumption. Fossil fuels are entirely imported, highlighting the nation's vulnerability to external energy dependencies. As of 2078-79 fiscal year, Nepal's installed electricity generation capacity stands at 2,205 megawatts, predominantly fueled by hydropower, with 94% of the population having access to electricity. Despite increasing per capita electricity consumption, which rose from 115.38 kWh in 2012 to 304 kWh in 2021, only a fraction of the economic hydropower potential has been harnessed, underscoring the need for further investment and development in Nepal's hydropower sector to meet growing energy demands and enhance energy security (Sharma, 2024).

Silveira et al. (2011) stated that journey of Nepal towards green energy exemplifies a strategic shift towards sustainable development. Through the adoption of off-grid technologies, particularly micro/mini hydro and solar photovoltaic systems, rural electrification has surged, fostering entrepreneurial endeavors and doubling the presence of installation and manufacturing companies, as well as non-governmental organizations (NGOs) in the renewable energy (RE) sector over the past decade. This paradigm has not only expanded the market for renewable energy but has also showcased the efficacy of mobilizing private finance and small businesses under robust public coordination, even in remote and impoverished regions (Gyanwali et al., 2022). The country's rich natural resources have been pivotal in driving this transition, further supported by initiatives such as rural energy subsidies, policy revisions, and tax exemptions on RE equipment, which have made RE solutions more accessible and affordable for villagers, propelling Nepal towards energy self-sufficiency and economic empowerment.

Moreover, Nepal's renewable energy landscape extends beyond electrification, with untapped potential in bioelectricity and renewable transport fuels. With only a fraction of energy consumption sourced from modern renewables, there lies a significant opportunity

to harness biomass, solar, and hydropower resources to meet energy demands sustainably (Gyanwali et al., 2022). Efforts to integrate bioethanol production from sugarcane molasses and surplus bagasse utilization in sugar mills underscore the multifaceted benefits of renewable energy adoption, from reducing reliance on fossil fuels to promoting agricultural modernization and industrial efficiency. These initiatives not only align with global green agendas but also present avenues for economic growth, job creation, and environmental stewardship, underscoring Nepal's pivotal role in shaping a greener and more resilient future (Silveira et al., 2011).

This study examines the multifaceted factors impacting the financial performance of small hydropower projects in Nepal. It comprehensively examines client-related, consultant-related, and project-related factors, alongside external environmental influences and contractual relationships. By thoroughly analyzing these variables, the research aims to provide valuable insights into the intricate dynamics shaping the financial viability and success of small hydropower ventures in Nepal. Through meticulous examination, it endeavors to offer actionable recommendations for stakeholders in the hydropower sector, promoting informed decision-making and fostering sustainable development in Nepal's renewable energy domain.

1.2 Problem Statement

The construction industry particularly within the realm of hydropower construction projects, grapples with formidable challenges that severely impact its performance. Despite the industry's crucial role in economic development, the profitability of hydropower construction projects lags behind other sectors, posing a threat to long-term business viability (Othman et al., 2017) Heightened competition, pricing pressures, and productivity issues compound the difficulties, making the attainment of necessary profitability an increasingly arduous task. Concurrently, the widespread occurrence of construction delays, recognized as pervasive and costly problems, not only jeopardizes project completion but also triggers disputes and lawsuits between project owners and contractors (Ahmad & Hossain, 2019).

Small hydropower projects play a significant role in addressing energy needs across the globe, particularly in both developed and developing countries. In developed countries, small hydropower is often integrated into existing infrastructure and serves as a complementary energy source to larger-scale hydropower facilities. These projects benefit

from established regulatory frameworks, technological advancements, and investment support, which contribute to their successful implementation and operation (Rasul et al., 2021). Developed countries prioritize sustainable energy solutions, and small hydropower aligns with their goals of reducing carbon emissions and enhancing energy security.

In Asian countries, including emerging economies, small hydropower projects are gaining traction due to their potential to meet growing energy demands sustainably. Governments in these regions are increasingly focusing on renewable energy sources to diversify their energy mix and reduce dependence on fossil fuels. Small hydropower offers numerous advantages, such as minimal environmental impact, reliable energy generation, and potential for local economic development (Rasul et al., 2021). However, challenges such as regulatory barriers, land acquisition issues, and financing constraints hinder the widespread adoption of small hydropower in Asian countries.

Within South Asia, where rapid population growth, urbanization, and industrialization are driving energy demand, small hydropower projects face both opportunities and challenges (Tortajada & Saklani, 2018). While the region boasts abundant water resources suitable for hydropower generation, ensuring equitable access to energy and addressing environmental concerns are paramount. South Asian countries, including Nepal, India, and Bhutan, have ambitious renewable energy targets and recognize the importance of small hydropower in achieving these goals. However, inadequate infrastructure, limited technical expertise, and socio-economic disparities pose significant hurdles to the development of small hydropower in the region.

Nepal, in particular, presents a compelling case for the expansion of small hydropower projects. With its vast network of rivers and mountainous terrain, the country has immense hydropower potential, estimated at over 40,000 MW. However, challenges such as inadequate funding, regulatory complexities, and lack of skilled manpower impede progress in the sector. Despite these obstacles, Nepal has made strides in promoting small hydropower through policy reforms, investment incentives, and capacity-building initiatives. The government's commitment to renewable energy development, coupled with support from international organizations, bodes well for the future of small hydropower in Nepal.

Small hydropower projects play a vital role in addressing energy needs across different regions, including developed countries, Asian economies, and South Asian nations like

Nepal. While each region faces unique challenges, such as regulatory barriers, financing constraints, and socio-economic disparities, the potential benefits of small hydropower, including sustainable energy generation, local economic development, and environmental conservation, make it a compelling energy solution (Ogino et al., 2019). By addressing these challenges through policy reforms, investment incentives, and capacity-building efforts, countries can unlock the full potential of small hydropower and contribute to a sustainable energy future.

Nepal's energy sector faces significant challenges due to its geographical and economic characteristics. With a predominantly rural population and limited infrastructure, providing reliable and affordable energy access to all citizens remains a daunting task. The country's high poverty rate, coupled with low average per capita income, exacerbates the energy poverty prevalent in many rural areas. Additionally, Nepal's lack of a robust energy research and development culture further complicates efforts to address these challenges effectively (Nepal, 2012). Despite these obstacles, Nepal possesses immense potential for renewable energy development, given its abundant natural resources, including hydropower, solar, and wind energy.

Efforts to address the demand and supply-side constraints in Nepal's energy sector require a multifaceted approach. Technology diffusion initiatives must account for sociological traditions and perceptions of risk associated with new innovations, particularly in rural communities. Access to financial resources and credit is also crucial for the adoption of capital-intensive technologies in less developed regions. Furthermore, policies aimed at promoting renewable energy adoption can play a pivotal role in diversifying Nepal's energy mix, reducing reliance on traditional energy sources, and fostering energy independence. By harnessing its renewable energy potential and implementing strategic policies, Nepal can enhance electricity access in rural areas, mitigate energy poverty, and reduce dependency on foreign fuel imports, thereby fostering sustainable development and economic growth (Nepal, 2012).

In the context of Nepal, numerous hydropower projects face substantial challenges, such as schedule and cost overruns, leading to escalated project costs and diminished profitability (NEA, 2012). The repercussions extend to additional financial burdens, including bank interest and fines imposed by regulatory bodies like the Nepal Electricity Authority for delayed project completion (Chiluwal & Mishra, 2017). Despite the critical role of the hydropower construction industry in Nepal's economic development,

stakeholders have not adequately addressed the persistent issue of cost overruns. The urgency lies in identifying the root causes of these challenges, particularly cost overruns and delays, to streamline project timelines and expenditures. Addressing these issues is imperative not only for the construction industry's improved performance but also for fostering economic development and ensuring the successful implementation of vital hydropower projects. Based on above discussed problem statement and identified research gap, following research questions have been raised

- What is the current status of factors affecting the financial performance of Small Hydropower Projects in Nepal?
- What is the relationship between client-related factors, consultant-related factors, project-related factors, the external environment, contractual relationships, and the financial performance of Small Hydropower Projects in Nepal?
- What is the impact of client-related factors, consultant-related factors, project-related factors, the external environment, and contractual relationships on the financial performance of Small Hydropower Projects in Nepal?

1.3 Objectives of the Study

The main objective of this study is to conduct a comprehensive analysis of the factors influencing the financial performance of small hydropower projects in Nepal. Furthermore, it aims to investigate the interrelationships between these factors and their impact on the financial performance of small hydropower projects. Through rigorous evaluation and analysis, the study endeavors to provide valuable insights into the intricate dynamics governing the financial viability and success of small hydropower projects in the Nepalese context. The objective of this study are as follows.

1. To assess the current status of factors affecting the financial performance of Small Hydropower Projects in Nepal.
2. To examine the relationship between client-related factors, consultant-related factors, project-related factors, the external environment, contractual relationships, and the financial performance of Small Hydropower Projects in Nepal.
3. To analyze the impact of client-related factors, consultant-related factors, project-related factors, the external environment, and contractual relationships on the financial performance of Small Hydropower Projects in Nepal.

1.4 Rationale of the Study

The rationale behind this study stems from the critical importance of small hydropower projects in Nepal's energy landscape and broader developmental goals. Firstly, small hydropower projects serve as intricate, interdisciplinary systems involving civil, mechanical, and electrical components (AEPC, 2011). Understanding the factors influencing their financial performance is crucial to establish benchmarks and enhance overall project efficiency (Sarangi et al., 2014).

Secondly, hydropower has long been recognized as a reliable and cost-effective energy source globally (IEA, 2016). Beyond its economic benefits, the success of hydropower projects depends on various environmental, social, and technical factors (Mayeda & Boyd, 2020). These projects often include reservoirs that offer control over energy production levels and provide additional benefits such as flood control, irrigation, and water supply management (Shaktawat & Vadhera, 2021).

Thirdly, Nepal's developmental trajectory heavily relies on hydropower to meet the increasing demands for socioeconomic growth and industrialization (ADB, 2015). Access to electricity plays a pivotal role in fostering economic activities, improving living conditions, and creating a cleaner environment (Nepal et al., 2021). Therefore, assessing the financial performance and profitability of hydropower projects is crucial for attracting investments and advancing Nepal's hydropower sector (Akcay et al., 2017).

Moreover, this study aims to provide valuable insights to a diverse range of stakeholders, including local experts, decision-makers, scholars, investors, and professionals in the hydropower industry (Tversky & Kahneman, 1992). Addressing the need for effective financial management in the sector is essential, as poor financial practices can negatively impact liquidity, turnover, and profitability (Jensen & Meckling, 1976). By recognizing the importance of profitability and considering capital structure variables, policymakers can develop evidence-based strategies to improve the financial performance of hydropower companies in Nepal (Rasul et al., 2021).

In conclusion, the rationale for this study lies in its potential to contribute to the sustainable development and growth of Nepal's hydropower sector (Nepal, 2012). By offering valuable insights and recommendations, this study aims to attract investments, promote sustainable development, and support decision-makers in achieving Nepal's energy and developmental objectives.

1.5 Limitations of the Study

Following has been the research limitation of this study.

- The reliance on primary data introduces inherent limitations, including potential biases, incomplete responses, and resource-intensive data collection processes.
- There may be a lack of adequate literature available to support the study, particularly concerning the specific context of small hydropower projects in Nepal.
- Not all relevant variables influencing the financial performance of hydropower projects may be included in the study, potentially limiting the comprehensiveness of the analysis.
- The focus solely on small hydropower projects may restrict the generalizability of the findings to other types of hydropower projects or renewable energy initiatives.
- The study's scope, which centers on analyzing the practice and performance of hydropower construction in terms of time and cost, may overlook other crucial aspects of project management and financial assessment.
- This study has limitations regarding variables, as only specific factors such as Client Related Factor, Consultant Related Factor, Project Related Factor, External Environment, and Contractual Relationship have been considered.
- The study is based on descriptive as well as causal-comparative research methodology, which only considers the quantitative nature of data.

CHAPTER II
LITERATURE REVIEW

The literature review in this study covers three four main aspects: conceptual, theoretical, and empirical and research gap. In the conceptual review, the study defines small hydropower projects (SHPs) and emphasizes their alignment with sustainable development goals in Nepal. Moving to the theoretical aspect, the research explores existing frameworks and theories related to SHPs, providing a theoretical foundation for analyzing their financial performance. The empirical review synthesizes previous research and real-world data, shedding light on current practices, trends, challenges, and factors influencing SHPs' financial performance. Identified research gaps include the need for a deeper understanding of specific challenges faced by SHPs, the efficacy of sustainable development strategies, and the necessity for more robust empirical studies to inform policy and practice in Nepal's SHP sector.

2.1 Theoretical Review

The theoretical review of this study encompasses several prominent theories relevant to the understanding of small hydropower projects (SHPs). Among these are Prospect Theory, which explores decision-making under risk and uncertainty; Goal-Setting Theory, which examines the role of goals in driving behavior and performance; Diffusion of Innovation (DOI) Theory, which elucidates the process by which innovations are adopted and spread within a society; and Agency Theory, which delves into the relationship between principals and agents in organizational settings. These theories provide valuable frameworks for analyzing various aspects of SHPs, including decision-making processes, innovation adoption, goal attainment, and agency relationships.

2.1.1 Prospect Theory

The study is based on prospect theory, which was developed by Kahneman and Tversky in 1979. This theory provides a descriptive model for decision-making under conditions of uncertainty, as noted by Han and Hsu (2013). According to prospect theory, investors assess risk in terms of potential gains and losses, with a concave value function for gains and a convex function for losses. This theory helps explain why investors may be willing to undertake risky projects with higher returns when effective risk management strategies are in place. For instance, in the context of this study, investors may find it more appealing to invest in risky hydroelectric energy projects if they incorporate appropriate

financial risk management instruments. These instruments, such as contingent capital, hedging derivatives, and insurance, can mitigate uncertainties and prevent revenue loss or cost overruns, thereby boosting investor confidence. Additionally, investors can tailor specific risk management instruments to each project based on the expected gains. However, without the integration of these instruments, risk-averse investors may perceive such projects as unattractive and continue to withhold support, leading to underinvestment.

Tversky and Kahneman (1992), introducing the concept of cumulative prospect theory, which elucidates lenders' and investors' behavior in engaging with risky yet lucrative projects with risk reduction strategies. Prospect theory has been applied in various financial contexts, including portfolio choices, trading behavior, and asset pricing anomalies. Despite this, the application of prospect theory to financial risk management in hydroelectric energy projects has not been thoroughly explored in the existing literature, prompting the current study to address this gap. By linking prospect theory to financial risk management instruments in securitizing hydroelectric energy projects, we aim to understand how investors can be attracted to funding risky yet high-return projects with assured revenue flow and debt repayment, even amidst uncertainties.

In this study, prospect theory offers a crucial lens through which to understand investor behavior and decision-making processes. By incorporating prospect theory into the study, we gain insights into how investors assess risk and make investment decisions, particularly in the realm of small hydropower projects. Understanding how investors perceive potential gains and losses, and how they weigh risk against return, can illuminate the factors influencing the financial performance of these projects. Moreover, prospect theory highlights the importance of effective risk management strategies, such as financial instruments like contingent capital and insurance, in mitigating uncertainties and attracting investment. By linking prospect theory to financial risk management in small hydropower projects, the study aims to provide a deeper understanding of how investors can be incentivized to fund these projects despite inherent risks, ultimately contributing to their financial success and sustainable development in Nepal.

2.1.2 Goal-Setting Theory

The study adopts Locke's goal-setting theory of motivation, which was developed in 1968 and further refined by Locke and Latham (2006). According to this theory, clear and

measurable goals are essential for effective project performance. These goals should be moderately challenging to motivate project parties, who must also be committed to achieving them. Additionally, there should be a feedback mechanism to track progress, and the complexity of goals should be understood to allocate adequate time for their attainment. For a project to succeed, project parties must prioritize and understand the goals effectively. Precise and challenging goals encourage innovative strategies and sustained effort toward project success. Strategic communication can foster goal commitment among project parties, inspiring them to prioritize their tasks. While goal-setting theory has been applied in various contexts, previous studies have not specifically examined its application in the context of hydroelectric energy projects, which this study seeks to address. Performance in this study is assessed based on efficient risk mitigation, cost reduction, operational efficiency, adherence to implementation schedules, increased production capacity, profitability, environmental safety, quality electricity supply, customer satisfaction, affordability of electricity, and ease of electricity access. Achieving these objectives signifies effective project performance (Locke & Latham, 2006).

2.1.3 Diffusion of Innovation (DOI) Theory

The communication strategy employed in this study is grounded in Rogers' diffusion of innovation theory, which was introduced in 1962. This theory elucidates the process, mechanisms, and pace at which new ideas, innovations, or technologies disseminate and are adopted within a given environment, in this case, financial risk management instruments in hydroelectric energy projects. According to the theory, for an innovation to gain traction and sustain itself, it must be effectively communicated over time among project stakeholders within the social system and must be widely embraced. To facilitate effective diffusion, four key elements must be considered: the innovation itself, the duration of communication, the communication channels utilized, and the social systems, which encompass the human capital competence of the stakeholders. Timely and efficient communication among project stakeholders, facilitated by a well-defined strategy outlining how project performance can be achieved, is crucial. Quality communication necessitates clear communication structures, organized management tools, cost-effective channels, and a clearly defined scope (Rogers, 1962).

Moreover, the communication strategy enhances understanding of the characteristics of project stakeholders in terms of their human capital competence regarding the utilization of financial risk management instruments, as well as their knowledge of the drivers and

barriers to adoption. The theory emphasizes the importance of raising awareness, facilitating open decision-making regarding the acceptance or rejection of new ideas, and implementing the innovation. For instance, project stakeholders should possess adequate knowledge of financial risk management instruments at the initial stages, receive persuasion from providers regarding their integration into hydroelectric energy projects, and voluntarily utilize these instruments to achieve project objectives. This process should include a feedback mechanism to assess the effectiveness of the instruments (Gilardi, 2010).

Effective communication strategies in project environments ensure proper evaluation of the relative advantages of financial risk management instruments, enhance their compatibility with the system, simplify their application complexity, and increase the likelihood of reinvention potential to mitigate risk effects and minimize potential losses. As projects involve a diverse group of individuals and their own system of objectives and processes, which create adoption complexity, it is crucial to develop an efficient communication strategy to understand the motivation and ability of stakeholders, the compatibility of the innovation with the system, and to assess the implications of financial risk management instruments in hydroelectric energy projects. While the theory has been successfully applied in various fields such as communication, public health, political science, project management, and marketing, its application to understand the moderating effect of communication strategy on the relationship between financial risk management instruments and the performance of hydroelectric energy projects remains unexplored, highlighting a gap to be addressed by the current study (Nyandika & Ngugi, 2014). Therefore, the current study will utilize the diffusion of innovation theory to elucidate the moderating effect of communication strategy on the relationship between financial risk management instruments and the performance of hydroelectric energy projects.

2.1.4 Agency Theory

The study has incorporated agency theory, established by Jensen and Meckling in 1976, to comprehend the significance of effective contract management in hydroelectric energy projects. This theory elucidates how the principal-agent conflict inherent in a project can be mitigated through well-defined optimal contracts outlining obligations for achieving project performance. In any project, the agent seeks to maximize their gains while minimizing the principal's economic objectives, and vice versa. This leads to information asymmetry between the parties, necessitating a contract agreement to establish a balanced

trade-off. Agency theory posits that the principal's wealth may not be maximized due to goal misalignment, information asymmetry, and differences in risk propensity between the agent and principal. In this study, agency theory aids in understanding the extent to which contract management mediates the relationship between financial risk management instruments and the performance of hydroelectric energy projects. Contract management involves ensuring stakeholder needs are met, achieving optimal conditions, funding efficiency, competitive procurement, risk management, quality consistency, adherence to implementation schedules, and cost-effectiveness. These factors may ultimately influence the performance of hydroelectric energy projects (Jensen & Meckling, 1976).

Informed by these theories, it becomes apparent that the acceptance and adoption of financial risk management instruments by project stakeholders depend on the communication strategy employed to introduce these ideas, aimed at enhancing the performance of hydroelectric energy projects, as well as effective contract management. Building on this understanding, the study conceptualizes that the performance of hydroelectric energy projects is contingent on the utilization of financial risk management instruments such as ART, contingent capital, credit enhancement, hedging derivatives, and insurance. These instruments are moderated by communication strategy and mediated by contract management, highlighting their interconnectedness in influencing project performance (Jensen & Meckling, 1976).

2.2 Conceptual Review

2.2.1 Definition of Small Hydropower Project

There isn't a universally accepted definition for small hydropower plants, and how they're categorized depends on each country's hydropower development level (Ferreira & Camacho, 2017). Table 1 illustrates the definitions and classifications used in various countries known for their significant contributions to small hydropower electricity generation globally.

Table 1

SHP definition and Classification in Some Selected Countries

Country/Organization	Micro (kW)	Mini (kW)	Small (kW)
Brazil	<100	101–1000	1001–30,000
China	≤100	≤2000	≤50,000
Philippines	-	51–500	<15,000
Sweden	-	-	101–15,000
USA	<500	501–2000	<15,000
India	<100	<2000	-
Japan	-	-	<10,000
Nigeria	≤500	501–2000	-
France	<500	501–2000	<50,000
New Zealand	-	<10,000	<50,000
United Kingdom	<1000	-	-
Canada	-	<1000	1001–1,500
Russia	-	-	<30,000
Norway	<100	101–1000	1000–10,000
Germany	<500	501–2000	<12,000
Turkey	<100	101–2000	<10,000

Source: (Ferreira & Camacho, 2017)

Okot (2013) classified the hydropower into three types. Hydropower plants come in three primary types: impoundment, diversion, and run-of-river. Impoundment systems involve large-scale generation where water is stored in reservoirs created by dams. In diversion systems, a canal or penstock redirects part of a river's flow to the generating equipment, often without the need for a dam. On the other hand, run-of-river systems leverage the natural flow of water in rivers, typically without impoundment. For small hydropower plants, the preference is often for the run-of-river approach, minimizing or eliminating the need for dams on-site. By harnessing the kinetic energy of flowing water to turn turbines, run-of-river systems mitigate the adverse impacts associated with large hydropower projects, such as land inundation and disruptions to river temperature and composition.

Choosing the run-of-river technology for small hydropower plants offers several advantages. It reduces the environmental footprint of the project site by avoiding significant alterations to river ecosystems and landscapes caused by impoundment. Additionally, the absence of large dams decreases the potential for negative impacts on local communities, such as displacement or loss of livelihoods due to flooding. Furthermore, run-of-river systems often entail faster and less complex construction

processes compared to impoundment projects, leading to reduced project costs and quicker deployment of renewable energy capacity. Overall, the adoption of run-of-river technology aligns with sustainable development goals by promoting clean energy generation while minimizing ecological disruption and maximizing local benefits (Kosnik, 2010).

2.2.2 Definition of Small Hydropower Project in Nepal

In the context of Nepal, small hydropower projects are characterized by their electricity generation capacity, typically falling below 100 kW. Specifically, micro-hydropower plants (MHPs) are emblematic of this category, exemplifying decentralized energy generation using hydropower resources. These MHPs are pivotal components of Nepal's energy landscape, with approximately 3300 community-owned and operated installations dispersed across the country. Fundamentally, the establishment and proliferation of MHPs in Nepal have been facilitated by subsidies administered by the Alternative Energy Promotion Centre (AEPC), underscoring the government's commitment to promoting renewable energy initiatives (APEC & Kathmandu, 2011).

Since the 1960s, concerted efforts by international donors have catalyzed the growth of a domestic micro-hydropower manufacturing industry within Nepal. This industry plays a pivotal role in producing the requisite generating equipment for MHPs, ensuring a self-reliant approach to energy infrastructure development. Community participation is integral to the inception and execution of MHP projects, with local residents contributing both financially and physically during the construction phase. Post-installation, communities assume ownership and operational responsibilities for the plants, signifying a decentralized and community-centric approach to energy provision (Butchers et al., 2021).

Despite the availability of alternative renewable energy technologies, such as solar, wind, and hybrid systems, micro-hydropower remains the predominant choice for electrification in Nepal's hilly and mountainous regions. The enduring preference for MHPs underscores their reliability, cost-effectiveness, and adaptability to the local terrain and hydrological conditions (Sarangi et al., 2014).

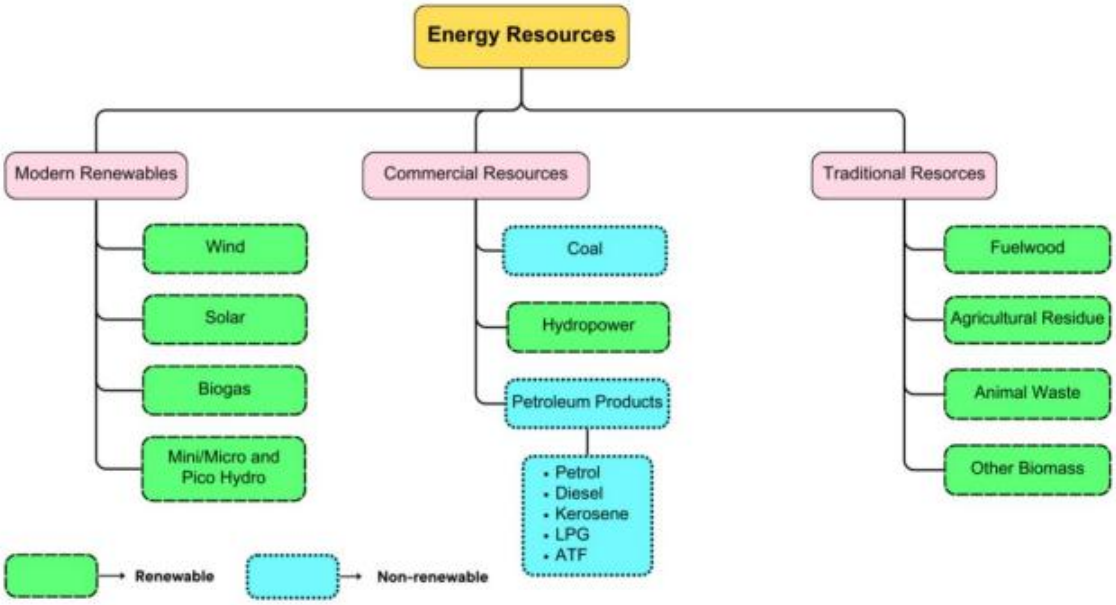
Micro-hydro and pico hydro systems represent small-scale hydroelectric power solutions, generating electricity with capacities below 100 kW and 1 kW, respectively. They leverage various technologies, such as Pelton Turbines and Cross Flow Turbines,

depending on water flow and elevation. Typically serving nearby households through decentralized mini-grids, these systems offer practical and cost-effective electricity solutions, especially in rural and remote areas where extending the national grid is challenging. While installations are concentrated in mountainous regions with abundant water sources, districts in the Terai region have fewer installations due to limited water flow and elevation for micro-hydro setups (WECS, 2023).

The trend in mini/micro hydro installations shows a positive trajectory, indicating increasing adoption of these technologies. For instance, in the fiscal year 2076/77, the installation rate rose to 34,870 kW, marking an 8.09% increase from the previous year's value of 32,159 kW. This upward trend continued with a 3.15% increase in 2077/78 and a 4.74% increase in 2078/79, reaching 37,734 kW (WECS, 2023).

2.2.3 Energy Resources (Supply and Generation) in Nepal

According to the International Energy Agency (IEA) report from 2016, Nepal's energy consumption is projected to rise due to a combination of population growth and increased economic activity (IEA, 2016). Over the period from 1990 to 2010, the energy demand from industries increased annually by 9%, while that of the transport sector grew at a rate of 6.4% per year (ADB, 2015). However, despite this growth, Nepal's overall energy demand remains one of the lowest in Asia (ADB, 2015). Although the total energy consumption in Nepal is relatively low, the energy intensity, which measures the amount of energy used per unit of GDP, is remarkably high. Nepal's energy intensity is 1.8 times higher than India and China, 4.5 times higher than Bangladesh, and 4.5 times the world average (NEEP, 2015). This high energy intensity suggests that Nepal has significant potential to increase both its energy usage for productive purposes and the efficiency of its production processes (ADB, 2015). In 2013, the sectors of transport, industry, and commercial and public services accounted for only 7%, 6%, and 2% of Nepal's energy consumption, respectively (IEA, 2016).



Source: (WECS, 2023)

Figure 1. Energy Resource in Nepal

Regarding the classification of energy resources, coal and petroleum products are considered non-renewable, while all other energy sources fall under the renewable category. Specifically, in the context of hydropower, there is a distinction based on scale. Mini/micro and Pico hydropower plants, with their smaller capacity, are classified as modern renewable resources. However, when discussing hydropower in general, including larger-scale hydropower plants, it is categorized as a commercial resource. This classification takes into consideration the economic impact and integration of hydropower into the national electricity grid (WECS, 2023).

2.2.4 Hydropower and Sustainable development Goal

Hydropower offers numerous advantages, including efficient freshwater resource management, mitigation of environmental impacts by reducing greenhouse gas emissions, and preparation for climate change-related challenges, leading to a decrease in associated health issues. Additionally, it contributes to achieving various sustainable development goals, such as providing affordable and reliable energy services, ensuring clean water and sanitation, and supporting infrastructure development and innovation, as well as combating climate change. Given the growing global concern about climate change, both developed and developing nations are increasingly focusing on clean and sustainable

energy sources, with hydropower playing a pivotal role due to its technological and cost-effectiveness as a renewable energy option (Kishore et al., 2021).

Hydropower, known for its renewable and environmentally friendly characteristics, remains economically viable, with ongoing efforts to improve plant performance and efficiency through significant infrastructure advancements. These include the construction of extensive headrace tunnels, the implementation of advanced governor control systems utilizing chaotic turbine regulating technology, and the integration of hydropower with large-scale solar PV and wind farms. Hydropower plants demonstrate the capability to manage dynamic load changes and frequency variations effectively. They also provide stability in fluctuating market conditions and offer promising solutions for energy storage through pumped storage plants. Despite the variable nature of hydropower generation influenced by weather patterns and local geography, approximately 20 GW of capacity was added in 2018, resulting in a global installed capacity of 1132 GW and an estimated energy generation of 4210 TWh. Hydropower plants exhibit inherent capabilities for rapid response to load variations, thereby enhancing the reliability of power networks. Pumped storage plants, in particular, are considered excellent options for managing peak demand. The cost of hydropower generation is not subject to inflation and decreases over time, offering development opportunities for remote and isolated regions. As the demand for integrating various renewable energy sources with the grid grows, hydropower is gaining increased attention due to its ability to effectively integrate with other renewables, particularly wind and solar, based on local conditions and synergistic benefits (Hosseini et al., 2005).

2.2.5 Small Hydropower Projects (SHP)

Small hydropower projects (SHPs) are hydroelectric power plants characterized by their relatively lower installed capacity, typically categorized based on megawatts. While larger hydropower plants often rely on reservoirs, SHPs are predominantly run-of-river systems, utilizing similar core components and technology. The increasing popularity of SHP plants can be attributed to the growing focus on renewable energy sources, driven by their economic, environmental, and social advantages over larger hydropower facilities (Dutta et al., 2014). These benefits include shorter construction times, reduced capital and operating costs, and the absence of dams or reservoirs, as SHPs are often designed as run-of-river systems. Consequently, they have a lesser environmental impact compared to larger projects. SHP projects can be implemented in various water bodies, such as rivers,

small streams, dams, and canals, with minimal observable environmental consequences. The emphasis on constructing and integrating SHP projects aims to mitigate environmental impacts while maximizing water conservation, leveraging water as a decentralized and cost-effective source of electricity, thus contributing to self-sufficiency in power generation (Mishra et al., 2011).

2.2.6 Current Practice of Hydropower Construction in Nepal

Constructing underground facilities, while providing a cost-effective solution for water conveyance and transportation in countries like Nepal with hilly terrains, can be challenging and expensive. The delicate geology of the Himalayas and significant overburden present obstacles during construction, leading to issues such as excessive bending and support failures in tunnels and subterranean structures. Previous hydroelectric tunnel projects in the region have encountered problems like high compression, roof collapse, water ingress, and face failure (Karki et al., 2020).

In a study by Mishra and Bhandari (2018), titled "Performance assessment of ongoing construction projects under town development fund, Nepal," various project planning and scheduling techniques were employed, including S-curves, critical path analysis, and bar charts, to track and control project progress on a weekly basis. Schedule coordination was successful at each project milestone, with MS Project software utilized for planning and scheduling. However, cost control measures lacked integration with concepts like earned value and real value, and software was not used for cost planning, monitoring, or control.

Additionally, safety considerations in construction projects were often insufficient. Many construction firms failed to adequately incorporate overall project safety elements, resulting in accidents and execution issues. Contractors frequently neglected to implement health and safety measures, while consultants lacked proper oversight and management of safety protocols (Mishra et al., 2018).

2.2.7 Recent Trends and Challenges of Small Hydropower Projects (SHP)

The energy sector is confronted with pressing economic, environmental, and developmental hurdles, compelling the pursuit of cleaner and more sustainable energy solutions. Amid mounting concerns regarding climate change and the environmental impact of fossil fuels, there's a growing imperative to transition towards renewable energy sources. Hydropower, with a global installed capacity of 1.3 terawatts (TW) and energy generation of 4.2 terawatt-hours (TWh) in 2018, is a significant contributor to the clean

energy landscape. However, the planning and design of hydropower projects must prioritize sustainability, ensuring minimal environmental impact. Small hydropower (SHP) emerges as a vital player in delivering clean energy, particularly in rural areas of developing nations. Many countries are actively addressing energy poverty and expanding access through SHP initiatives. Additionally, SHP supports advanced economies in meeting renewable energy targets and reducing greenhouse gas emissions. This discussion examines current trends in the small hydro sector, identifies industry challenges, and explores potential solutions to overcome these obstacles (IEA, 2020).

2.2.8 Performance of Small Hydropower Projects (SHP)

Performance measurement is a systematic approach utilized in manufacturing and construction sectors to evaluate project performance by analyzing inputs, outputs, and overall project outcomes (Zhang & Fan, 2009). Despite increased attention from researchers and industry stakeholders over the past two decades, comprehensive performance assessment remains relatively uncommon among businesses (Bhatti et al., 2013). Current measurement systems often prioritize product outcomes over process and design aspects, potentially leading to inaccurate assessments of relative performance and a lack of appropriate recognition for deserving parties. Research indicates that both financial and non-financial indicators, or a combination of both, can effectively measure performance. However, there is a tendency to attribute project failure to the performance of contractors, consultants, and management teams, neglecting the roles of other project participants such as customers, suppliers, trade contractors, and the public (Abdul-Rahman et al., 2009). The building sector significantly influences the economies of nations, and performance measurements are utilized at various levels, including industry, firm, project, and activity levels (Assaf et al., 1995). While efficiency is often emphasized at the business level, industry-level indicators like productivity are crucial. Sustainability metrics, encompassing environmental, economic, and social dimensions, are increasingly integrated into project evaluations, particularly in building projects. Waste management, a component of the productivity formula, significantly impacts sustainability, particularly in economic and environmental aspects (Bhatti et al., 2013).

2.2.9 Factors Affecting Financial Performance of Small Hydropower Projects (SHP)

The financial performance of small hydropower projects (SHP) is influenced by various factors related to project characteristics, contractual relationships, external environments,

client-related factors, and consultant-related factors (Chiluwal & Mishra, 2018). Project characteristics play a significant role, with factors such as project size, complexity, completion period, availability of skilled workers, material quality control, and timely supply impacting costs and timelines. Contractual relationship factors include effective communication, feedback mechanisms, control mechanisms, safety, and quality assurance programs, all of which influence project execution and financial outcomes. External environments encompass economic, social, political, and physical factors, including weather patterns, geological conditions, technology adoption, and adverse conditions like strikes and blockades, which affect construction efficiency and costs. Client-related factors such as experience, organization size, decision-making abilities, and communication skills contribute to successful project implementation and financial performance. Consultant-related factors, including commitment, involvement, cooperation, adequacy of design, and decision-making speed, also play a crucial role in project execution and financial outcomes. Financial performance measures such as revenue, net present value, internal rate of return, and operating expenses are used to assess profitability and financial sustainability, aiding in decision-making and improvement strategies (Zhang & Fan, 2009). Despite increased attention from researchers and industry stakeholders over the past two decades, comprehensive performance assessment remains relatively uncommon among businesses (Bhatti et al., 2013). Current measurement systems often prioritize product outcomes over process and design aspects, potentially leading to inaccurate assessments of relative performance and a lack of appropriate recognition for deserving parties. Research indicates that both financial and non-financial indicators, or a combination of both, can effectively measure performance. However, there is a tendency to attribute project failure to the performance of contractors, consultants, and management teams, neglecting the roles of other project participants such as customers, suppliers, trade contractors, and the public (Abdul-Rahman et al., 2009). The building sector significantly influences the economies of nations, and performance measurements are utilized at various levels, including industry, firm, project, and activity levels (Assaf et al., 1995). While efficiency is often emphasized at the business level, industry-level indicators like productivity are crucial. Sustainability metrics, encompassing environmental, economic, and social dimensions, are increasingly integrated into project evaluations, particularly in building projects. Waste management, a component of the productivity formula, significantly impacts sustainability, particularly in economic and environmental aspects (Bhatti et al., 2013).

2.2.10 Financial Model of Hydropower Plant

The financial model of a hydropower plant serves as a crucial analytical tool in corporate finance, enabling comprehensive evaluation and comparison of projects. Built upon initial project data and a set of assumptions, this model employs standard mathematical and statistical methods to generate accurate predictions of future outcomes. Fundamental principles of financial modeling include encompassing all significant aspects of the hydropower project and future events, covering an analysis period that allows for reasonably accurate predictions, and facilitating the generation of financial statements such as income statements and balance sheets (Näsäkkälä & Keppo, 2008).

Moreover, a dynamic nature is essential for the model, enabling adjustments to important financial variables with corresponding recalculations of results. Notably, revenues and costs for each project activity are modeled separately, considering observed trends in real-world projects. Given the substantial investments required for hydropower plant construction, typically at least 2 million euros per 1 MW of installed capacity, a high-quality financial model plays an indispensable role in long-term planning. Such models often span an investment period of 5-7 years, encompassing various stages of forecasting financial results (Güven & Şebcioğlu, 2019).

These stages include making assumptions for financial analysis, developing profit-maximizing strategies, forecasting revenues and production costs, budgeting project expenditures and funding sources, planning financial costs and loan repayments, and conducting detailed assessments of profitability and risk. However, creating a financial model for a hydropower plant entails gathering and processing a vast amount of information, subject to future uncertainty (Näsäkkälä & Keppo, 2008). It demands complex calculations considering objective changes and stakeholder positions on specific issues.

Thus, the success of financial modeling relies heavily on the expertise, practical experience, and technical capabilities of the financial team, as well as access to relevant project information. Overall, a well-constructed financial model serves as a cornerstone for informed decision-making and strategic planning in hydropower project development.

2.2.11 Analysis of the Financial Needs of the Hydropower Project

To assess the financial viability of a hydropower project, a comprehensive model is necessary, reflecting the structure of revenues and costs while considering current

regulations and market conditions (Forouzbakhsh et al., 2007). This entails a thorough evaluation of project assets as the foundation for subsequent analyses. Various economic methods are employed for project valuation, including comparative analysis, real options valuation, and discounted cash flow analysis. Each method offers insights into the project's potential value and risks, aiding in the determination of optimal financing scenarios. However, the accuracy of the financial model depends on precise data, underscoring the importance of a professional approach to data collection and analysis.

Comparative analysis of the financial needs of hydropower projects involves assessing the asset value based on similar assets in the local market. This process utilizes a multiplier system to compare the reference asset with the asset under analysis (Mishra et al., 2011). Two approaches are commonly used: comparing the hydropower project with assets sharing similar characteristics or evaluating the project's performance against historical data of mature assets. While the latter approach is simpler, it necessitates careful consideration of uncertainties and assumptions, highlighting the importance of expertise in conducting such analyses.

Investment costs in hydropower projects typically encompass civil works, electromechanical equipment, and pre-investment expenses. Civil construction costs, particularly significant in large projects, are influenced by labor costs and local building materials availability. Conversely, small-scale projects rely heavily on the cost of electromechanical equipment (İpin & Ercan, 2021). Moreover, pre-investment research, environmental impact studies, and licensing fees constitute significant components of the financial model. Understanding these cost dynamics is crucial for accurately estimating project expenses and optimizing financial strategies for hydropower development.

2.3 Empirical Review

Daneshgar and Zahedi (2022) conducted a study aimed at investigating the production and profitability of hydropower plants using a system dynamics approach. The main objective of the research was to develop a dynamic production-profitability model to simulate the operation of a hydro reservoir system and analyze the profitability process for producers. The study utilized STELLA software in an object-oriented simulation environment to implement the system dynamics approach. Monthly time series data from 2010 to 2020 were utilized, with forecasts made for 24 months. The research focused on analyzing the profitability of hydropower plants, specifically using data from the Karun 1

Dam in the Karun river catchment area. Uncertainties related to water inlet flow status and electricity prices were predicted using the Gómes model and incorporated into the model. Various scenarios, including different water release methods and acceptable costs, were considered. The findings revealed that the scenario involving a 15% discharge of the dam resulted in the highest profit, amounting to $3047 per MW for the 24th month.

Yap and Yap (2021) conducted a comprehensive review to discuss the future potential of Hydropower Generation (HG) in Malaysia, focusing on publications available in the Scopus database from 1970 to 2021. Their objective was to analyze the economic, social, and environmental aspects of hydropower generation in Malaysia based on the selected papers. The study reviewed a total of 15 papers, including 12 from the Scopus database and 3 non-Scopus papers. It was found that the majority of the reviewed papers (73%) primarily discussed the economic aspect of HG in Malaysia, highlighting its significance in the planning and implementation processes of renewable energy (RE) projects in the country. Additionally, 27-47% of the papers also addressed social and environmental aspects, which were often intertwined with economic considerations. The analysis revealed that a significant portion of the reviewed papers focused on Micro (< 100 kW) Hydropower Systems (HPS), indicating their potential for contributing to reduced energy costs and promoting social development in Malaysia. Overall, the findings suggest that economic factors play a crucial role in shaping the future of hydropower generation in Malaysia, with Micro HPS showing promising prospects for enhancing the nation's well-being and sustainable energy transition.

Jahan et al. (2022) conducted a study aiming to address the complexity associated with integrating causative risk factors influencing construction profitability using a system dynamics (SD) approach. The researchers identified the existing gap in literature, which primarily focuses on individual effects of profitability-influencing factors without considering the systemic impact and associated dynamics. To fill this gap, the study employed systems thinking (ST) and SD modeling to assess causative interrelations and interdependencies among profitability-influencing risk factors (PIRFs) in construction projects. Through a comprehensive literature review and content analysis, significant PIRFs were identified and ranked. Subsequently, structured surveys and expert opinion meetings were conducted to prepare for quantitative and qualitative evaluations. A causal loop diagram (CLD) was developed using the ST technique, and the integrated effects of PIRFs on profitability-influencing risk categories (PIRCs) were quantified using SD

modeling. The study identified rising material costs, supply chain processes, payment issues, planning and scheduling problems, financial difficulties, and effective control of manpower and equipment resources as the most critical PIRFs. The integrated effects of these factors on PIRCs were evaluated through SD modeling. The findings of this study provide valuable insights for field professionals in diagnosing profitability-influencing factors and integrating their impacts into decision-making and policy formulation. Additionally, it offers a roadmap for future research by presenting a list of factors that can be investigated in detail, along with their holistic interrelationships.

Nepal et al. (2021) conducted a study to analyze the relative importance of risks associated with hydropower projects and project finance in Nepal, particularly under the framework of Public-Private Partnership (PPP) model. With hydropower being the primary internal source of electricity in Nepal and the increasing involvement of Independent Power Producers (IPPs) under PPP arrangements, effective risk management is essential to ensure project sustainability and prevent failure. The study focused on four major categories of risks: Hydropower Sector Specific Risks, Project Finance Specific Risks, Hydropower Project Financing Risks, and Country Specific Political and Legal Risks. Utilizing self-administered surveys and questionnaires among IPPs and domestic Banking and Financial Institutions (BFIs), the researchers employed Relative Importance Indices (RII) to assess the importance of each risk factor. Critical risks identified include exchange rate changes, currency mismatch between local revenue and foreign loans, cost and time overruns, inflation, political turmoil, and a highly volatile political environment. The findings emphasize the necessity of proper risk allocation among stakeholders to ensure project bankability, highlighting that no risk should be neglected, and understanding the relative importance of risks is crucial in effective risk allocation and management, particularly in infrastructure projects like hydropower.

Roy and Roy (2020) conducted a study focusing on risk management in small hydropower (SHP) projects in Uttarakhand, aiming to address the hesitancy among investors to invest in the sector due to uncertainties surrounding project costs. The paper proposes an innovative approach to negotiate a trade-off between insurance companies and investors, leveraging a risk index derived from investment risk analysis. The methodology employed for risk index assessment utilizes the applied fuzzy logic approach, which enables the classification of thirty-six SHP projects into various risk classes and suggests a variable premium range for insurance policies. The study aims to

support investors in making informed investment decisions, aid insurance companies in developing variable insurance premium policies, and assist policymakers by identifying sensitive pain points in the sector. This approach offers a comprehensive framework for mitigating risks associated with SHP projects, thereby fostering greater investor confidence and facilitating the growth of the SHP sector in Uttarakhand.

Mayeda and Boyd (2020) conducted a systematic literature review aiming to synthesize and consolidate the results of studies examining the factors influencing public perceptions of hydropower projects. The review focused on quantitative and qualitative empirical research published between 1980 and 2018, analyzing 49 articles that met the inclusion criteria out of an initial search yielding 21,171 articles. The study aimed to understand the factors associated with local residents' support for or opposition to hydropower developments, particularly emphasizing the perspectives of those living near current or proposed energy developments. The primary factors influencing public perceptions included environmental and ecological impacts, local socio-economic impacts, and public participation and consultation practices associated with the development, including the availability of information. Additionally, the review examined differences in factors influencing public perceptions between developed and developing economies. The findings provide valuable insights into the development of more effective communication strategies and hydropower policy, emphasizing the importance of considering local perspectives and addressing key concerns to foster greater support for hydropower projects.

Li (2019) conducted a profitability analysis of hydropower enterprises, focusing on listed companies with GGEP as a case study. The study aimed to assess the profitability of hydropower companies and discuss the environmental factors influencing their profitability. The analysis emphasized the importance of technological innovation, particularly in leveraging new technologies and Internet technology for hydrological monitoring and fishery breeding. The study highlighted the role of environmental protection in shaping new development opportunities for hydropower enterprises and emphasized the need for these companies to improve their competitiveness through optimizing financial management, reducing operational costs, expanding market channels, and enhancing overall profitability.

Mishra and Chiluwal (2018) conducted a study to identify the factors affecting the performance of small hydropower construction projects in Nepal. The main objective was

to determine the relative importance of these factors in influencing project performance. The study highlighted several key factors, including quality control of materials, adequacy of design and specification, overall management practices, availability of skillful workers, and supply of materials. The research revealed a positive correlation in the ranking of factors among clients, consultants, and contractors. It emphasized that while time management and cost-saving are important, they alone do not enhance construction performance. Factors such as social issues and internal management also play vital roles. The study concluded that incorporating the identified factors into practice is essential for enhancing the performance of hydropower construction projects in Nepal.

Butchers et al. (2019) conducted a study to investigate the technical, economic, and social factors affecting micro-hydropower plants in Nepal. The main objective was to understand the performance and reliability of these plants, which are crucial for providing electricity to rural areas in Nepal where access to the national grid is limited. The researchers examined 24 sites, comprising 18 Crossflow and 6 Pelton turbines, and conducted interviews with plant operators, managers, and consumers to gain insights into how the plants are operated and managed, as well as their impact on the local community. A quantitative assessment of maintenance and observation of 10 sub-systems at each site were also conducted. The findings revealed that micro-hydropower plants are highly valued due to their significant social and economic impact. However, 40% of managers reported that monthly payments were insufficient to cover repair costs, indicating financial challenges. Sites with trained operators exhibited better maintenance practices. The study identified problems in various sub-systems that could affect performance and increase running costs across all sites. Overall, the research provides valuable insights into the factors influencing the operation and sustainability of micro-hydropower plants in Nepal.

Walczak (2018) assessed the performance of the SHP from technical and hydraulic perspectives while considering principles of sustainable development. Walczak analyzes various parameters such as water head, flow rate velocity, and the shape of trash rack bars to understand their effects on expected SHP profits. The assessment of hydraulic performance involves investigating the impact of reduced flow rate and water head on power output and energy production, focusing particularly on the Francis turbine installed in the facility. Additionally, the study extends to analyze the composition and weight of plant debris accumulated on trash racks in the inlet channel, which affects channel

capacity and hydraulic performance. Field research includes collecting organic material during different seasons to understand its impact on the system. Technical conditions are evaluated based on the current state of the inlet channel, and simulations are conducted to assess the deteriorating state's impact on energy generation and economic benefits. The findings contribute to understanding how to optimize SHP operations in line with sustainable development principles, considering both technical and environmental factors.

Akcay et al. (2017) aimed to estimate the profitability of hydropower investments, with a case study from Turkey. Given the increasing energy demand and the need for renewable energy sources, hydropower plants are considered feasible investments, often organized as public-private partnerships (PPPs). However, conducting feasibility studies for such investments requires consideration of risk factors stemming from the macro environment and project conditions. The main objective of the research is to develop a method to predict the profitability of hydropower investments while accounting for relevant risk factors. The researchers set up a cash flow representing the construction and operation period, identify risk factors involved in such projects, assess the impacts of these risk factors on cash flow parameters, and perform Monte Carlo simulation to estimate the net present value (NPV) of a hydropower investment. The proposed method is tested on a hydropower investment in Turkey and yields credible results that can benefit potential investors operating in similar conditions. The primary contribution of the research lies in creating a method that enables investors to assess the profitability of hydropower investments using a stochastic approach.

Abd Hamid et al. (2017) investigated the factors influencing mini hydro power production efficiency, focusing on Malaysia. With energy consumption projected to increase significantly by 2030, there was a growing need to expand the use of renewable energy sources to address concerns about pollution from fossil fuels. The researchers examined the impact of weather conditions, such as rainfall, temperature, and humidity, alongside system factors, on power generation by mini hydropower plants in the east coast region of Malaysia. Data collected from the Malaysian Meteorological Department spanning six years was analyzed statistically to determine the correlation between these factors and power generation. The findings revealed that humidity and rainfall had a significant effect on mini hydro power generation, suggesting that these variables could be utilized to predict energy production. The study concluded by proposing the application of machine learning methods, such as support vector machine and artificial

neural network, for future research to enhance predictions of energy production by mini hydro power plants.

Table 2

Summary Table of Empirical Review

S. N.	Authors	Title	Research Objectives	Variables	Methodology	Findings	Research Gap
1	Danesh gar and Zahedi (2022)	Investi gating the hydrop ower plants product ion and profita bility using system dynami cs approa ch	To study the profitabil ity of hydropo wer plants using the informati on of Karun 1 Dam in the catchmen t area of Karun river.	Storage, Risk, Planning, Decision making	Research Design- Analytical Research Design Population - All Hydropower Sample Size- Specific Hydropower of Karun River Sampling Design - Judgmental Sampling Source of Data - Secondary Data Tools- Regression Analysis using STELLA software Data Collection Procedure - Downloaded and Trend Model- System Dynamic Approach	Adopting a correct decision-making method for the optimal operation of power plants is always one of the main concerns for hydropower Project	Context Gap- only Karun River Dam Time Gap- 2010-2020 Data Variable- only concentrat ed on Cost, Planning, Economic Model Methodolo gy Gap- System Dynamic and Only Regression Model used.
2	Yap and Yap (2022)	Hydrop ower Genera tion in Malays ia: A Review and Some Notes	To analyze the future potential of Hydropo wer Generati on (HG) in Malaysia	Social and Economi c Factor	Research Design- Case Study research design Population - All hydropower of Malaysia Sample Size- 15 paper reviewed Sampling Design - Convenience Sampling Source of Data - Secondary	Social and Economic aspects has impact on performance of mini and micro hydropower	Context Gap- Conducted in Malaysia Time Gap- data from 1970 to 2021 used

S. N.	Authors	Title	Research Objectives	Variables	Methodology	Findings	Research Gap
					Tools- Descriptive Analysis Data Collection Procedure - Download data Model- Review Approach		
3	Jahan et al. (2022)	Modeling Profitability-Influencing Risk Factors for Construction Projects: A System Dynamics Approach	To assess causative interrelations and interdependencies between profitability influencing risk factors (PIRF)	Faulty Execution, Specification Changes, Communication Issues, Competitive Bidding Pressure, Contract Management Issues, Coordination Complexity, Cost Escalation, Construction Risk, Critical Path Delays, Supplier Dependency	Research Design- Qualitative and Quantitative Population - All employee of Construction Projects Sample Size- 250 Respondents Sampling Design - Source of Data - Primary Tools- SPSS Software using Reliability test, Relative importance index, loop analysis Data Collection Procedure - Structured Survey Model- System Dynamic Modeling	Rising cost of material, supply chain process, payment issues, planning and scheduling problems, financial difficulties, and effective control of manpower and equipment resources as the most critical PIRFs.	Context Gap- Outside Nepal Time Gap- Concluded in 2022 Variable Gap - Execution, Specification Changes, Communication Issues, Competitive Bidding Pressure, Contract Methodology Gap- System Dynamic Modeling is used
4	Nepal et al. (2021)	Relative Importance of Risks in Hydropower Projects and Project Finance in Nepal	To analyze the major risks including Hydropower Sector in profitability	Specific Risks, Project Finance Specific Risks, Hydropower Project Financing Risks and Country Specific	Research Design- Descriptive and Analytical Study Population - Total Hydropower related stakeholder Sample Size- 54 Participants Sampling Design - Convenience	Exchange rate changes, currency mismatch between local revenue and foreign loan, cost and time overrun, inflation, political	Time Gap- Before 2021 Variable Gap -Risk Factor Methodology Gap- Descriptive, Ranks Analysis

S. N.	Authors	Title	Research Objectives	Variables	Methodology	Findings	Research Gap
				Political and Legal Risks	Sampling Source of Data - Primary Sources Tools- Descriptive Statistics, Ranks Data Collection Procedure - Questionnaire survey and Semi Structured Interview Model- Cross Sectional Data Research Design- Exploratory	turmoil and highly volatile political environment are few of the most critical risks found	only
5	Roy and Roy (2020)	Risk management in small hydropower (SHP) projects of Uttarakhand: An innovative approach	Risk management and profitability of Hydropower Project	Technical, geological, regulatory, financial, environmental, Socioeconomic Factor	Research design Population - All hydropower projects of Uttarakhand Sample Size- 36 projects Sampling Design - Purposive sampling Source of Data - Primary Sources Tools- Fuzzy Logic System Data Collection Procedure Structured Questionnaire Survey- Model- Fuzzy Logic Approach	six major risk factors are environmental, geological and hydrological, technical, financial, regulatory, and socio-economic has been the main determinants of hydropower performance	Context Gap- Project of Uttarakhand Time Gap- Before 2020 Variable Gap- Technological, regulatory factor, geological factor Methodology Gap- Fuzzy Logic Approach
6	Mayeda and Boyd (2020)	Factors influencing public perceptions of hydropower projects: A systematic literature	To analyze the public perception toward factor affecting financial Performance of Hydropower Projects	Socio-Economical Aspects, environmental and ecological, consultation Factor	Research Design- Qualitative and Quantitative Population - 21171 Articles Sample Size- 49 Articles Sampling Design - Purposive Sampling Source of Data - Secondary	The primary factors that influenced locally affected public perceptions of hydropower projects included: (1) environmental and ecological	Time Gap- 1980 to 2018 Data research Variable Gap- Social, Economical, consultation factor

S. N.	Authors	Title	Research Objectives	Variables	Methodology	Findings	Research Gap
		review			Tools- Descriptive Analysis Data Collection Procedure - Download Article Model- Review Approach	impacts of the development; (2) local socio-economic impacts associated with the hydropower project; and (3) public participation and consultation practices associated with the development including availability of information.	Methodology Gap- Review Approach
7	Li (2019)	Profitability analysis of hydropower enterprises - Take GGEP as an example	To analyze the profitability of hydropower project in China	Cost profit margin, operating gross margin, operating gross margin and financial expense ratio, etc., the index data	Research Design- Descriptive Analysis Population - All Hydropower of China Sample Size- Hydropower operated under GGEP Program Sampling Design - Convenience Source of Data - Secondary Tools- Descriptive Analysis Data Collection Procedure - published Annual report Model- Descriptive model	Environmental related factor affect the profitability of hydropower in China	Context Gap- Conducted in China Variable Gap- Environment related factor only Methodology Gap- Descriptive Analysis only

S. N.	Authors	Title	Research Objectives	Variables	Methodology	Findings	Research Gap
8	Mishra and Chiluwal (2018)	Factors Affecting Performance of Small Hydropower Construction Projects in Nepal	to identify the factors with their relative importance of Hydropower Performance	Client Related Factor Consultant Related Factor Project Related Factor External Environment Contractual Relationship	Research Design- Qualitative Research Design Population - All 53 hydropower projects in Nepal Sample Size- All employee of Project Parties Sampling Design - Random Sampling Source of Data - Primary and Secondary Tools- Factor, Rank, Correlation analysis Data Collection Procedure - Questionnaire Survey, Interview Model- Correlation Analysis	Quality control of material, Adequacy of design and specification, Overall management action, Skillful workers, insufficient supply of materials were the most significant factor affecting the performance of Construction Project.	Time Gap- Before 2017 Methodology Gap- Qualitative Research design with Rank, Factor and Correlation analysis
9	Butchers et al. (2018)	A Study of Technical, Economic and Social Factors Affecting Micro-Hydropower Plants in Nepal	To analyze the factor affecting performance of hydropower project in Nepal	Technical, Economic, Social Factor	Research Design- Descriptive Research Design Population - All hydropower project of Nepal Sample Size- 28 sites of micro hydropower Sampling Design - Convenience Source of Data - Primary Tools- Mean and T Test Data Collection Procedure - Interview Model- Case Study model	The social and economic impact at home and in the community mean that micro-hydropower plants are highly valued which affect the financial performance	Time Gap- Conducted before 2018 Variable Gap- Technical, Economic and Social factor only Methodology Gap- Mean and T-Test

S. N.	Authors	Title	Research Objectives	Variables	Methodology	Findings	Research Gap
10	Walczak (2018)	Operational Evaluation of a Small Hydropower Plant in the context of Sustainable Development	To examines the work of a Small Hydropower Plant (SHP) in Jaracz in technical and hydraulic terms	Technical Factors like Hydraulic Press, power loss, Power Flow	Research Design- Descriptive and Analytical Population - All Hydropower of Polland Sample Size- Small Hydropower plant Sampling Design - Judgmental Sampling Source of Data - Secondary Tools- Description Data Collection Procedure - Collection of data from related Field Model- Description	The most important factor affecting hydraulic losses, and thus economic ones, is the adoption of appropriate shapes of trash rack bars at the design stage of new hydropower plants or during the renovation of existing facilities.	Context Gap- Conducted in Polland Time Gap- Concluded by taking data of 2018 Variable- Technical factor of hydropower performance Methodology Gap- Descriptive Analysis
11	Akcay et al. (2017)	Estimating the profitability of hydropower investments with a case study from turkey	To analyze the profitability of hydropower investments considering the relevant risk factors.	External Risk Factors (law, Government, availability of Material, import, inflation, and Technical Risk Factors (Design, delay, quality, coordination)	Research Design- Analytical Research Design Population-575 Hydropower of Turkey Sample Size- Small Hydropower conducted under PPP model Sampling- Purposive/ Judgmental Source of Data - Secondary Tools-Monte Carlo Simulation Data Collection Procedure - Extensive Literature Survey Model- Stochastic	Technical factors and risk factors are main determinants of profitability of hydropower in Turkey	Context Gap- Conducted in Turkey Time Gap- Before 2017Sampling -575 Variables Gap- Technical Risk and External Risk Factors Methodology Gap- Analytical Research with Monte Carlo Simulation

S. N.	Authors	Title	Research Objectives	Variables	Methodology	Findings	Research Gap
					Approach.		
12	Abd Hamid et al. (2017)	Factors affecting mini hydro power production efficiency: A case study in Malaysia	To study how these factors affecting the power generation by mini hydro power plant in east coast region, data sets are collected from Meteorological Department Malays	Humidity and Rain Fall	Research Design- Analytical Population - All Hydropower of Malaysia Sample Size- Mini Hydropower of Malaysia Sampling Design - Convenience Sampling Source of Data - Secondary Data Tools- Correlation and Regression Analysis Data Collection Procedure - Download of data from report of hydropower Model- Multivariate regression Model	Humidity and rainfall have significant effect on power generation and financial performance by mini hydro	Context Gap- conducted in Malaysia Time Gap- January 2010 to December 2015 Variable- Gap Humidity and Rainfall

2.4 Research Gap

Previous research in the field of small hydropower projects (SHPs) in Nepal which include studies by Daneshgar and Zahedi (2022); Yap and Yap (2022); Jahan et al. (2022); Nepal et al. (2021); Roy and Roy (2020); Mayeda and Boyd (2020); Li (2019); Mishra and Chiluwal (2018); Butchers et al. (2018); Walczak (2018); Akcay et al. (2017); and Abd Hamid et al. (2017) have provided significant insights into factors affecting SHPs have various aspects of their development and operation. However, a significant research gap exists regarding the specific factors influencing the financial performance of these projects in the Nepalese context. Despite numerous studies examining different facets of SHPs, none have comprehensively investigated the factors directly impacting their financial viability. Therefore, there is a crucial need for empirical research focused

explicitly on understanding the factors that contribute to or hinder the financial success of SHPs in Nepal.

In terms of the time gap, existing research has predominantly relied on data collected up to a certain point in the past, with limited studies incorporating the latest available information. The absence of recent data hinders the ability to capture the current dynamics and trends affecting SHPs. This study addresses this time gap by utilizing the latest available data up to the year 2024, providing a more up-to-date understanding of the financial performance of SHPs in Nepal.

Furthermore, there is a notable gap in the variables considered in previous studies concerning SHPs' financial performance. While some research has explored factors such as technical, environmental, and socio-economic aspects, key variables such as client-related factors, consultant-related factors, project-related factors, external environment factors, and contractual relationships have not been comprehensively examined. This study aims to bridge this gap by incorporating a broader range of variables to provide a more comprehensive understanding of the financial performance determinants of SHPs.

Another significant gap lies in the methodology utilized in previous research on SHPs in Nepal. While some studies have employed descriptive statistics and qualitative approaches, there is a lack of causal-comparative research designs that allow for a deeper analysis of causal relationships and comparisons across different variables. By adopting a causal-comparative research design alongside descriptive statistics, this study seeks to overcome this methodology gap and provide a more robust analysis of the factors influencing SHPs' financial performance.

Overall, the identified research gaps highlight the need for a focused investigation into the factors influencing the financial performance of SHPs in Nepal, incorporating the latest available data, a broader range of variables, and a rigorous methodology. This study endeavors to address these gaps by providing a comprehensive analysis that contributes to a deeper understanding of SHPs' financial viability in the Nepalese context.

CHAPTER III
RESEARCH METHODOLOGY

This chapter provides an overview of the research methodology employed in the study. It encompasses various aspects such as the research design, population and sample selection, sampling design, nature and sources of data, instruments of data collection, method of analysis, research framework, and definition of variables. Each of these components contributes to the systematic and rigorous approach adopted to investigate the research questions and achieve the study objectives. By delineating the methodological framework, this chapter lays the groundwork for conducting a comprehensive and insightful analysis of the factors influencing the financial performance of small hydropower projects.

3.1 Research Design

A research design combining descriptive statistics and causal comparative analysis has been used to analyze the effect of client-related factors, consultant-related factors, and project-related factors, the external environment, and contractual relationships on the financial performance of Small Hydropower Projects in Nepal. Descriptive statistics provides the status of key factors used in this study like client-related, consultant-related, project-related, and environment-related factors, providing a clear snapshot of the current conditions. The causal-comparative approach has enabled the exploration of causal relationships between these identified factors and the financial performance outcomes, shedding light on the specific dynamics impacting small hydropower projects in the Nepalese context. Through this methodological framework, the study aims to contribute valuable insights to the understanding of the intricate interplay between these factors and financial performance in the realm of small hydropower projects in Nepal.

3.2 Population and Sample, and Sampling Design

A total of 53 small hydropower projects in Nepal collectively produce 37,734 kW of energy (WECS, 2023). The entire workforce of these 53 projects constitutes the study's total population.

A sample size of 200 respondents has been deemed sufficient for this study based on the specialized nature of the research focusing on small hydropower projects in Nepal. Given the limited population directly involved or impacted by these projects and the practical

constraints of data collection, a smaller sample size is deemed appropriate. Additionally, the homogeneity of the target population and the qualitative nature of the research objectives further support the adequacy of this sample size in capturing rich and diverse insights into the factors influencing the financial performance of small hydropower projects. Data collection will employ a convenience sampling method. Participants will include individuals affiliated with small hydropower companies, users of hydropower services, consultants, local residents impacted by the projects, and other relevant stakeholders.

Table 3

Sample Size

Sample from employee of	No. of Samples
Hydropower Project	50
Hydropower Consultant	50
Hydropower Contractor	50
Hydropower Constructor (Developer)	50
Total	200

3.3 Nature and Sources of Data

The research has used quantitative nature of data, drawing primary data directly from stakeholders within the hydropower and electricity sector. This method ensures the collection of reliable and relevant data to comprehensively analyze the factors influencing the financial performance of small hydropower projects in Nepal.

3.4 Data Collection Procedure

A questionnaire survey technique has been chosen as the method for data collection, utilizing a five-point Likert scale as the instrument for gathering responses. This structured questionnaire survey instrument has aimed to efficiently capture quantitative insights from the respondents, providing a systematic and standardized means of assessing their perspectives and opinions. The questionnaire has been adopted from Chiluwal and Mishra (2018) for data collection. The utilization of a Likert scale has facilitated the quantification of responses, enabling a statistical analysis to uncover patterns and trends related to the research objectives in the realm of hydropower and electricity in this study.

In data collection, printed questionnaires have been distributed to respondents through personal and professional relationships, as the researcher is also employed at Nepal

Electricity Authority, where they interact with numerous employees of Hydropower Projects, Hydropower Consultants, Hydropower Contractors, and Hydropower Constructors (Developers). Approximately 250 questionnaires were distributed, with approximately 200 responses received, yielding an approximate 80 percent response rate.

3.5 Instrumentation

To measure the research variables, the questionnaire is divided into three categories. The first category covers the demographic profile of respondents, including gender, age group (in years), academic qualifications, and designation. The second category uses a five-point Likert scale, based on Chiluwal and Mishra (2018), with options ranging from "Very Low Important" (1) to "Very High Important" (5). This section includes seven factors related to project characteristics, seven statements on contractual relationships, nine statements on the external environment, eleven statements on client-related factors, and ten statements on consultant-related factors. The third category measures financial performance with nine statements, also adapted from Chiluwal and Mishra (2018), using a Likert scale from "Strongly Disagree" (1) to "Strongly Agree" (5). This comprehensive yet streamlined approach ensures the collection of relevant and reliable data for analyzing the factors affecting the financial performance of small hydropower projects in Nepal.

3.6 Method of Analysis

After data collection, the gathered data has been meticulously organized and inputted into statistical software packages like Microsoft Excel and SPSS. Subsequently, the data has been subjected to thorough analysis employing various statistical tools including descriptive statistics, correlation analysis, and multivariate regression modeling. This rigorous analytical process has aimed to unveil meaningful insights, relationships, and patterns within the dataset, facilitating a comprehensive understanding of the factors influencing the financial performance of small hydropower projects in Nepal. Following statistical tools has been used in this study.

3.6.1 Descriptive Statistics

The choice to utilize descriptive statistics aligns with the first objective of the study, which aims to assess the current status of factors affecting the financial performance of small hydropower projects in Nepal. By employing measures such as mean and standard deviation, the study seeks to summarize the perceptions of employees and consultants regarding these factors. Therefore, descriptive statistics serve as a foundational tool for

achieving the study's objective of examining the current status of factors influencing financial performance.

3.6.1.1 Mean

The mean has been selected as a key statistical measure in this study to provide a concise summary of respondents' perceptions regarding factors influencing the financial performance of small hydropower projects in Nepal. By calculating the average response across all participants, the mean offers a representative indicator of the central tendency of the dataset. This approach enables researchers to capture the collective viewpoint of respondents and identify prevailing attitudes or sentiments towards the factors under investigation. Utilizing the mean facilitates the interpretation of survey data by providing a single numerical value that reflects the typical perception or level of importance attributed to each factor. As a widely recognized and intuitive measure of central tendency, the mean allows for straightforward comparisons and insights into the overall perceptions of stakeholders involved in the small hydropower sector in Nepal.

3.6.1.2 Standard Deviation (S.D.)

In this study, the standard deviation (S.D.) is utilized to gauge the variability in respondents' perceptions regarding factors influencing the financial performance of small hydropower projects in Nepal. A higher S.D. indicates greater diversity in opinions among participants, highlighting areas of contention or differing viewpoints within the sample population. Conversely, a lower S.D. suggests greater uniformity or consensus among respondents, indicating widespread agreement on certain factors. Thus, S.D. serves as a crucial measure to determine the variability of people's perceptions in the study.

3.6.2 Correlation Analysis

Correlation analysis is a statistical method used to measure and assess the strength and direction of the relationship between two or more variables (Ghauri & Gronhaug, 2010). In this study, correlation analysis serves as a crucial tool for examining the relationships between various factors, including Client Related Factor, Consultant Related Factor, Project Related Factor, External Environment, Contractual Relationship, and the financial performance of small hydropower projects in Nepal. By quantifying the degree and direction of association between these factors, correlation analysis helps to identify

potential patterns and dependencies that may exist among them, thereby providing valuable insights into their interrelationships.

3.6.3 Regression Analysis

Regression analysis is a statistical method used to investigate the relationship between a dependent variable and one or more independent variables (Hair et al., 2017). In this study, multivariate regression analysis has been employed to examine the impact of client related factor, consultant related factor, project related factor, external environment, and contractual relationship on the financial performance of small hydropower projects in Nepal. By analyzing the simultaneous effects of multiple predictors on the dependent variable, multivariate regression allows for a comprehensive understanding of how various factors influence financial performance in the context of small hydropower projects. The regression model used in this study is as follows.

$Y_{FPR} = \alpha + \beta_1$ CLI + β_2CNS + β_3PRO + β_4EXT + β_5CNR+ E……. Eq. (i)

Where,

FPR = Financial Performance

CLI = Client Related Factor

CNS = Consultant Related Factor

PRO = Project Related Factor

EXT = External Environment

CNR = Contractual Relationship

E = Error Term

α = Intercept term

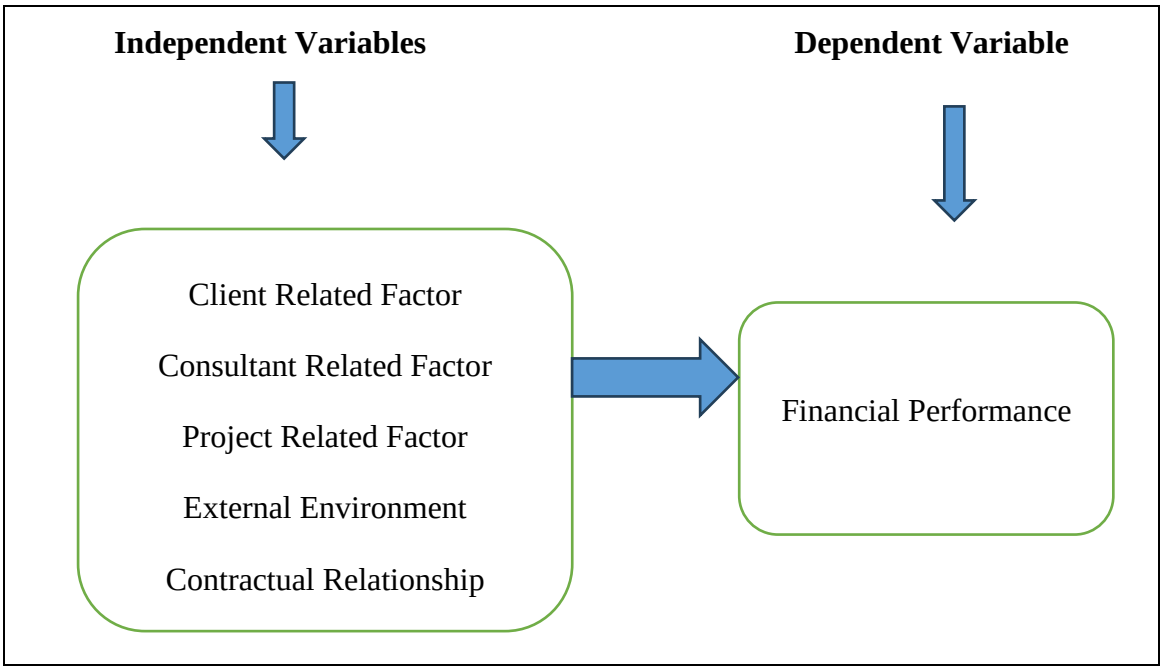
$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5 =$ Coefficients

3.7 Research Framework and Definition of Variables

The research framework serves as the blueprint for structuring and conducting the analysis of variables within a study. It provides a theoretical foundation that guides researchers in understanding the interrelationships among different factors under investigation. In this study, the research framework was adopted from Chiluwal and

Mishra (2018), offering a structured approach to examining the relationships between the dependent variable, financial performance (FP), and several independent variables. These independent variables encompass project-related factors (PR), contractual relationship (CR), client-related factors (CLR), consultant-related factors (CONS), and external environment (EE). By leveraging this established framework, the study was able to systematically evaluate how these variables interact and influence the financial performance of small hydropower projects in Nepal.

The adoption of the research framework from Chiluwal and Mishra (2018) provided a comprehensive and well-defined structure for the analysis conducted in this study. By utilizing an established framework, researchers were able to ensure consistency and rigor in their approach to examining the relationships between various factors impacting the financial performance of hydropower projects. This framework facilitated the organization of data collection, analysis, and interpretation, enabling researchers to effectively assess the influence of project-related, contractual, client-related, consultant-related, and environmental factors on the financial outcomes of small hydropower projects in Nepal.



Source: Chiluwal and Mishra (2018)

Figure 2. Research Framework of the Study

3.5.2 Operational Definition of Variables

Client Related Factor

Client Related Factor refers to various aspects related to the client or project owner that can influence the financial success of a hydropower project. This factor encompasses the client's experience in the hydropower industry, the size of the organization, priorities regarding cost efficiency or project speed, decision-making capabilities, and the effectiveness of communication channels (Chiluwal & Mishra, 2018). A client with extensive experience in hydropower and efficient organizational structures may contribute to better planning and decision-making, thus positively impacting financial outcomes. Effective communication and clear project objectives from the client's side are crucial for successful project implementation and financial performance. This definition is also supported by (Nepal, et al. 2021), (Butchers et al. 2018).

Consultant Related Factor

Consultant Related Factor involves the attributes and actions of the consulting firm or professionals engaged in the hydropower project (Chiluwal & Mishra, 2018). This factor includes the commitment, involvement, and cooperation of consultants with project stakeholders, the adequacy of design specifications, their experience in hydropower projects, decision-making speed, and the timely issuance of project drawings. A committed and experienced consultant team that effectively collaborates with stakeholders, provides accurate and timely designs, and demonstrates efficient decision-making can significantly influence project outcomes and financial success. This factor is supported by Jahan et al. (2022) and Roy and Roy (2020).

Project Related Factor

Project Related Factor pertains to various characteristics inherent to the hydropower project itself that impact its financial performance (Mayeda & Boyd, 2020). These factors include the size of the project, its complexity in terms of engineering and terrain challenges, the stipulated completion period for the contractor, availability of skilled labor, quality control measures for materials, fluctuations in material prices, and timely supply of materials. The successful management of these project-related factors is essential for controlling costs, ensuring timely completion, and maintaining quality standards, all of which contribute to the project's financial success. This is also supported by Yap and Yap (2022).

External Environment

External Environment encompasses the external factors and conditions surrounding the hydropower project, which can influence its financial performance (Shaktawat & Vadhera, 2021). This includes economic conditions, social dynamics, political stability and policies, physical environment considerations such as weather patterns and geological conditions, technology adoption, and potential external disruptions. Understanding and adapting to these external factors are critical for mitigating risks, optimizing project operations, and ultimately achieving financial success. This statement is also supported by Mayeda and Boyd (2020) and Jahan et al. (2022).

Contractual Relationship

Contractual Relationship covers the interactions and agreements among project participants, including the client, contractors, consultants, and other stakeholders. This factor includes effective communication channels, feedback mechanisms, control mechanisms for project activities, overall management practices, safety and quality assurance programs, realistic timelines, and timely delivery of materials. A well-established contractual relationship with clear communication channels, effective feedback mechanisms, and adherence to timelines and quality standards can positively impact project efficiency and financial performance (Zhang et al., 2018). This statement is also supported by Mayeda and Boyd (2020) and Butchers et al. (2018).

Financial Performance

Financial Performance encompasses various metrics used to evaluate the overall financial success of the hydropower project (Chiluwal & Mishra, 2018). These metrics include revenue generation, net present value, internal rate of return, return on equity, payback period, operating expenses, debt service coverage, cost of sales, net profit margin, and cash flow. Assessing these financial performance indicators provides insights into the project's profitability, efficiency, and financial sustainability, guiding decision-making processes and identifying areas for improvement. This statement is supported by Butchers et al. (2018), Akcay et al. (2017), Abd Hamid et al. (2017) and Roy and Roy (2020).

CHAPTER IV
RESULTS AND DISCUSSION

This chapter intricately examines the multifaceted factors influencing the financial performance of small hydropower projects in Nepal. It meticulously dissects demographic characteristics relevant to these projects, providing crucial insights into the socio-economic landscape within which they operate. Furthermore, the chapter meticulously conducts descriptive statistical analyses, offering a detailed overview of various financial indicators and performance metrics. This in-depth examination sets the stage for subsequent correlation and regression analyses, which explore the intricate relationships between different variables and the financial performance of small hydropower projects. Moreover, the findings are meticulously compared and contrasted with existing research in the field, facilitating a nuanced understanding of how the identified factors align with or diverge from previous findings. This rigorous scrutiny enhances the credibility and relevance of the study's conclusions, paving the way for insightful discussions on the implications of the findings for stakeholders involved in small hydropower projects in Nepal.

4.1 Results

In this section, the results of the descriptive study, correlation analysis, and regression analysis are presented in tabular form and analyzed. The descriptive study provides an overview of the data and correlation and regression analysis examines highlighting key metrics and trends related to client related factor, consultant related factor, project related factor, external environment, and contractual relationship. The correlation analysis examines the relationships between these independent variables and the dependent variable, financial performance, identifying significant associations. The regression analysis delves deeper, exploring the impact of the independent variables on financial performance, and offering insights into predictive relationships.

4.1.1 Demographic Profile of Respondents

In this section, the demographic profile of respondents, including gender, age group (in years), academic qualifications, and designation, has been examined. This analysis provides insights into the characteristics of the survey participants, offering a detailed understanding of the distribution and diversity within the respondent pool.

Table 4

Demographic Profile of Respondents

Variables		Frequency	Percent
Gender	Male	113	56.5
	Female	87	43.5
Age Group (in years)	Below 30	95	47.5
	30 to 50	85	42.5
	50 and above	20	10.0
Academic Qualifications	SLC	26	13.0
	10+2	33	16.5
	Bachelors	88	44.0
	Masters or above	53	26.5
Designation	Employee	98	49.0
	Consultant	30	15.0
	Developer	22	11.0
	Contractor	50	25.0

Source: Field Survey, 2024

Table 4 presents the demographic profile of respondents, illustrating the distribution of participants across different variables. In terms of gender, out of 200 respondents, 113 were male (56.5%), while 87 were female (43.5%). Regarding age groups, the majority of respondents, with a frequency of 95 (47.5%), fell below the age of 30, followed by 85 (42.5%) aged between 30 and 50, and 20 (10.0%) who were 50 years old and above. Academic qualifications varied among the respondents, with 26 (13.0%) having completed SLC, 33 (16.5%) holding a 10+2 qualification, 88 (44.0%) possessing a bachelor's degree, and 53 (26.5%) having obtained a master's degree or higher. Designation-wise, respondents comprised 98 employees (49.0%), 30 consultants (15.0%), 22 developers (11.0%), and 50 contractors (25.0%).

4.1.2 Descriptive Statistics

In the descriptive statistics section, a detailed description of the current status of factors affecting the financial performance of small hydropower projects in Nepal has been examined. This analysis provides an overview of how various elements, such as client-related factors, consultant-related factors, project-related factors, external environment, and contractual relationships, influence the financial outcomes of these projects.

Table 5

Summary of Descriptive Statistics

Variables	Code	Mean	S.D.
Client Related Factor	CLI	3.583	0.681
Consultant Related Factor	CNS	3.586	0.687
Project Related Factor	PRO	3.518	0.712
External Environment	EXT	3.618	0.683
Contractual Relationship	CNR	3.581	0.717
Financial Performance	FPR	3.651	0.692

Source: Field Survey, 2024

Table 5 presents the descriptive study of factors affecting the financial performance of hydropower respondents. The mean score for Client Related Factor (CLI) is 3.583 (S.D. = 0.681), corresponding to a medium level of importance (3) attributed to factors related to the client or project owner. These factors include the client's experience, decision-making capabilities, and communication effectiveness. Respondents perceive these aspects as moderately influential in determining financial success.

The Consultant Related Factor (CNS) has a mean score of 3.586 (S.D. = 0.687), also indicating a medium level of importance (3). Factors such as consultant commitment, experience, and cooperation with stakeholders are perceived similarly as moderately influential in financial performance.

Project Related Factor (PRO) has a mean score of 3.518 (S.D. = 0.712), reflecting a medium level of importance (3) attributed to characteristics inherent to the hydropower project itself. Factors such as project size, complexity, and completion period are perceived similarly as moderately influential in financial outcomes.

The External Environment variable (EXT) has a mean score of 3.618 (S.D. = 0.683), indicating a medium to high level of importance (between 3 and 4) attributed to external factors and conditions surrounding hydropower projects. Economic conditions, social dynamics, and political stability are perceived as moderately to highly influential in financial performance.

Contractual Relationship (CNR) has a mean score of 3.581 (S.D. = 0.717), reflecting a medium level of importance (3) attributed to interactions and agreements among project participants. Effective communication channels, feedback mechanisms, and adherence to timelines are perceived similarly as moderately influential in financial outcomes.

Financial Performance (FPR) stands out with the highest mean score of 3.651 (S.D. = 0.692), corresponding to a medium to high level of importance (between 3 and 4). Respondents perceive financial performance metrics as moderately to highly influential in determining the overall success of hydropower projects.

4.1.3 Correlation Analysis

In this study, correlation analysis has been used to examine the relationship between client-related factors, consultant-related factors, project-related factors, external environment, contractual relationships, and the financial performance of small hydropower projects in Nepal. This approach helps to identify the strength and direction of associations between these independent variables and the dependent variable, providing insights into how various aspects of project management and external conditions influence the financial outcomes of hydropower projects.

Table 6

Correlation Matrix

Variables		CLI	CNS	PRO	EXT	CNR	FPR
CLI	Pearson Correlation	1					
	Sig. (2-tailed)						
CNS	Pearson Correlation	.740**	1				
	Sig. (2-tailed)	0.000					
PRO	Pearson Correlation	.652**	.624**	1			
	Sig. (2-tailed)	0.000	0.000				
EXT	Pearson Correlation	.694**	.739**	.604**	1		
	Sig. (2-tailed)	0.000	0.000	0.000			
CNR	Pearson Correlation	.629**	.692**	.671**	.619**	1	
	Sig. (2-tailed)	0.000	0.000	0.000	0.000		
FPR	Pearson Correlation	.706**	.775**	.603**	.647**	.596**	1
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	

Source: Field Survey, 2024

Table 6 presents the correlation between independent variables (client related factor, consultant related factor, project related factor, external environment, and contractual relationship) and the dependent variable (financial performance). The Pearson correlation coefficient between financial performance and client related factor (CLI) is r = 0.706,

indicating a strong positive correlation,suggesting that as the client-related factors increase, financial performance also tends to increase.

The Pearson correlation coefficient between financial performance and consultant related factor (CNS) is r = 0.775, indicating a strong positive correlation, suggesting that as the consultant-related factors increase, financial performance also tends to increase.

The Pearson correlation coefficient between financial performance and project related factor (PRO) is r = 0.603, indicating a moderate positive correlation, suggesting that as the project-related factors increase, financial performance also tends to increase.

The Pearson correlation coefficient between financial performance and external environment (EXT) is r = 0.647, indicating a moderate positive correlation, suggesting that as the external environmental factors increase, financial performance also tends to increase.

The Pearson correlation coefficient between financial performance and contractual relationship (CNR) is r = 0.596, indicating a moderate positive correlation, suggesting that as the contractual relationship factors increase, financial performance also tends to increase.

4.1.4 Regression Analysis

In this study, regression analysis has been used to examine the impact of client-related factors, consultant-related factors, project-related factors, external environment, and contractual relationships on the financial performance of small hydropower projects in Nepal. This method allows for a detailed understanding of how each independent variable influences the dependent variable, providing a comprehensive assessment of the factors that significantly affect the financial outcomes of these projects.

Table 7

Model Summary of Regression Model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.805	0.648	0.638	0.416

Source: Field Survey, 2024

Table 7 presents the model summary of the regression model for predicting financial performance (FPR) based on the predictors: client related factor (CLI), consultant related factor (CNS), project related factor (PRO), external environment (EXT), and contractual

relationship (CNR). The model shows a significant relationship (R = 0.805, R Square = 0.648) between the predictors and financial performance. The adjusted R Square value (0.638) suggests that approximately 63.8% of the variance in financial performance can be explained by the predictors included in the model. The standard error of the estimate (0.416) indicates the average difference between the observed values and the predicted values by the model.

Table 8

ANOVA Table of Regression Model

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	61.728	5	12.346	71.291	0.000
	Residual	33.595	194	0.173		
	Total	95.323	199			

Source: Field Survey, 2024

Table 8 displays the ANOVA table of the regression model for predicting financial performance (FPR) based on the predictors: client related factor (CLI), consultant related factor (CNS), project related factor (PRO), external environment (EXT), and contractual relationship (CNR). The model's regression sum of squares is 61.728, with 5 degrees of freedom, resulting in a mean square value of 12.346. The F-statistic of 71.291 indicates a significant overall relationship between the predictors and financial performance. Moreover, the p-value (Sig.) of 0.000, being less than 0.05, suggests that the model is fit for analysis, implying that at least one of the predictors significantly contributes to explaining the variance in financial performance.

Table 9

Beta Coefficient of Regression Model

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	0.446	0.180		2.477	0.014		
	CLI	0.231	0.072	0.228	3.232	0.001	0.366	2.734
	CNS	0.499	0.077	0.495	6.494	0.000	0.313	3.194
	PRO	0.109	0.062	0.112	1.758	0.080	0.450	2.225
	EXT	0.056	0.069	0.056	0.813	0.417	0.390	2.565
	CNR	0.001	0.064	0.001	0.010	0.992	0.418	2.391

Source: Field Survey, 2024

Table 9 provides the beta coefficients for the regression model analyzing the impact of various independent variables on the dependent variable, Financial Performance (FPR). The Client Related Factor (CLI) exhibits a notable unstandardized coefficient (B) of 0.231, implying that a one-unit increase in CLI is associated with a 0.231-unit increase in FPR. The corresponding standardized coefficient (Beta) of 0.228 indicates a moderate positive relationship between CLI and FPR. With a significant p-value of 0.001, CLI significantly influences FPR at the 5% level of significance. Additionally, the variance inflation factor (VIF) of 2.734 is less than 10, indicating no multicollinearity concerns.

In case of Consultant Related Factor (CNS), its unstandardized coefficient (B) stands at 0.499, suggesting that for each unit increase in CNS, FPR is expected to increase by 0.499 units. The standardized coefficient (Beta) of 0.495 reflects a strong positive relationship between CNS and FPR. This relationship is statistically significant ($p < 0.001$), indicating that CNS significantly impacts FPR at the 5% level of significance. Furthermore, the VIF value of 3.194 is below 10, indicating no multicollinearity issues for CNS.

Examining the Project Related Factor (PRO), its unstandardized coefficient (B) is 0.109, indicating that a one-unit increase in PRO results in a 0.109-unit increase in FPR. The corresponding standardized coefficient (Beta) of 0.112 suggests a weak positive relationship between PRO and FPR. While the significance level ($p = 0.080$) is borderline, PRO's impact on FPR at the 5% level of significance is not significant impact. However, the VIF value of 2.225 is below the threshold of 10, indicating no multicollinearity concerns for PRO.

Turning to the External Environment (EXT), its unstandardized coefficient (B) is 0.056, indicating a minimal increase of 0.056 units in FPR for each unit increase in EXT. The standardized coefficient (Beta) of 0.056 signifies a weak positive relationship between EXT and FPR. However, the p-value of 0.417 suggests that EXT does not significantly influence FPR at the 5% level of significance. Despite this, the VIF value of 2.565 indicates no multicollinearity issues for EXT.

The analysis of the Contractual Relationship (CNR) reveals an unstandardized coefficient (B) of 0.001, indicating that a one-unit increase in CNR leads to a mere 0.001-unit increase in FPR. The corresponding standardized coefficient (Beta) of 0.001 suggests an extremely weak positive relationship between CNR and FPR. Moreover, the p-value of 0.992 implies that CNR does not exert a significant influence on FPR at the 5% level of significance. Additionally, the VIF value of 2.391 is below 10, indicating no multicollinearity concerns for CNR. The regression equation of this study came as below.

$$Y_{FPR} = 0.446 + 0.228\ CLI + 0.495\ CNS + 0.112\ PRO + 0.056\ EXT + 0.001\ CNR + E$$

4.2 Discussion

The first objective of this study is to assess the current status of factors affecting the financial performance of Small Hydropower Projects in Nepal. The findings indicate that factors such as Client Related Factor (CLI), Consultant Related Factor (CNS), Project Related Factor (PRO), External Environment (EXT), and Contractual Relationship (CNR) are perceived to have moderate to medium-high importance. Notably, the external environment (FPR) is highlighted as the most critical factor, with the highest mean score, underscoring its paramount importance in determining the overall success of hydropower projects. The findings of this study corroborate with previous research, particularly Yap and Yap (2022), Roy and Roy (2020), Li (2019), Butchers et al. (2018), and Mishra and Chiluwal (2018), which emphasize the importance of factors such as the external environment (FPR) in influencing the financial performance of small hydropower projects (SHPs). This alignment underscores the consistent recognition of certain determinants across multiple studies, indicating their critical role in project success. The divergence from studies such as Daneshgar and Zahedi (2022), Jahan et al. (2022), Nepal et al. (2021), Mayeda and Boyd (2020), and Akcay et al. (2017) highlights potential discrepancies in contextual factors or methodological approaches. While these studies may prioritize different variables or employ alternative analytical frameworks, the

variations underscore the complexity of assessing SHP performance and the need for comprehensive research to account for diverse perspectives and contexts.

The second objective of this study is to examine the impact of client-related factors, consultant-related factors, project-related factors, the external environment, and contractual relationships on the financial performance of Small Hydropower Projects in Nepal. The correlation analysis shows strong positive and statistically significant relationships between financial performance and each independent variable. This indicates that as these factors improve, financial performance tends to increase correspondingly, highlighting the interconnectedness and interdependence of these factors in influencing the financial outcomes of small hydropower projects in Nepal. The findings of this study regarding the positive and significant relationships between financial performance and various independent variables align with previous research conducted by Roy and Roy (2020), Li (2019), and Butchers et al. (2018). This consistency underscores the robustness of the identified relationships and reinforces the notion that factors such as client-related, consultant-related, project-related, environmental, and contractual factors play pivotal roles in influencing SHP financial outcomes across different studies. However, the results diverge from studies conducted by Daneshgar and Zahedi (2022), Jahan et al. (2022), and Nepal et al. (2021), suggesting potential contextual variations or methodological disparities. While this study highlights strong positive correlations between financial performance and various factors, these discrepancies underscore the complexity of assessing SHP performance and the need for comprehensive research to account for diverse contexts and analytical approaches.

The third objective of this study is to analyze the impact of various factors on the financial performance of Small Hydropower Projects in Nepal. The regression analysis reveals that client-related and consultant-related factors have a significant positive impact on financial performance, highlighting their crucial role in enhancing financial outcomes. Conversely, project-related factors, the external environment, and contractual relationships show weak and statistically insignificant impacts, indicating that these factors have a minimal effect on financial performance. Overall, the findings suggest that improvements in client and consultant-related aspects are key to boosting financial performance, while other factors have a less pronounced or negligible impact. Comparing these findings with the first objective of the study, which assessed the current status of factors affecting SHP financial performance, reveals intriguing insights. The alignment

with studies such as Roy and Roy (2020), Li (2019), and Butchers et al. (2018) underscores the consistent recognition of the importance of client-related and consultant-related factors across different analyses. However, the divergence from studies like Daneshgar and Zahedi (2022), Jahan et al. (2022), and Nepal et al. (2021) suggests potential variations in the perceived significance of these factors or methodological disparities. Additionally, the lack of alignment with research such as Mayeda and Boyd (2020) and Akcay et al. (2017) highlights the complexity of assessing SHP financial performance and the need for nuanced approaches to account for contextual variations. While some studies may prioritize certain factors over others or employ different analytical frameworks, the synthesis of findings from various studies contributes to a more comprehensive understanding of the factors shaping SHP outcomes in Nepal.

CHAPTER V
SUMMARY AND CONCLUSION

In this concluding chapter, a comprehensive summary of the study's key findings is presented, encapsulating the essence of the research journey. The summary distills the intricate analyses of demographic characteristics, descriptive statistics, and correlation and regression analyses pertaining to small hydropower projects in Nepal. It provides a concise overview of how these factors collectively influence the financial performance of such projects, offering a clear picture of the research landscape. Following the summary, the chapter transitions into the conclusion and implications of the study. Here, the overarching implications of the findings are discussed, shedding light on their significance for academia, industry, and policy makers. The conclusion also reflects on the limitations of the study and suggests avenues for future research to build upon this foundation. Overall, this chapter serves as a culmination of the study's efforts, presenting a coherent narrative of its findings and their broader implications.

5.1 Summary

This study examines the intricate dynamics surrounding the financial performance of small hydropower projects in Nepal, a country heavily reliant on hydropower for domestic electricity. With the government's encouragement of private sector involvement in the hydropower industry and the proliferation of Independent Power Producers (IPPs), understanding the financial landscape of these projects becomes imperative. Additionally, amidst global energy demand growth and the urgency to transition to sustainable energy sources, the study holds significance not only for Nepal but also on a global scale. The abundance of small rivers in Nepal presents vast potential for hydropower generation, underscoring the need to identify and address factors influencing the financial viability and profitability of such projects. Against this backdrop, the study aims to comprehensively analyze factors such as client-related, consultant-related, project-related, external environmental, and contractual relationship factors. By evaluating the current status of these factors and exploring their interrelationships, the research seeks to provide valuable insights into the drivers of financial performance in the context of small hydropower projects in Nepal. Through rigorous analysis, the study endeavors to contribute to informed decision-making processes, promote sustainable energy development, and foster economic growth in Nepal and beyond.

Second Chapter of the dissertation presents a comprehensive literature review, examining various aspects related to small hydropower projects (SHPs). The review is organized into three main sections: conceptual review, theoretical review, empirical review, and research gap analysis. In the conceptual review section, key theoretical frameworks such as Prospect Theory, Goal-Setting Theory, Diffusion of Innovation (DOI) Theory, and Agency Theory are explored to provide a theoretical foundation for understanding the dynamics of SHPs. Additionally, the definitions of SHPs, particularly in the context of Nepal, are elucidated, along with discussions on energy resources, hydropower's role in sustainable development goals, and the current practices and challenges associated with SHPs. The theoretical review delves into the empirical evidence and studies conducted in the field of SHPs, highlighting key findings, methodologies, and gaps in existing research. Finally, the research gap analysis identifies areas where further investigation is warranted, aiming to contribute to the existing body of knowledge on SHPs and inform future research endeavors.

The research design for this study encompasses a combination of descriptive statistics and causal-comparative analysis, aiming to scrutinize the impact of client-related factors, consultant-related factors, project-related factors, the external environment, and contractual relationships on the financial performance of Small Hydropower Projects (SHPs) in Nepal. Descriptive statistics offer insights into the current status of key factors, providing a snapshot of prevailing conditions. Meanwhile, the causal-comparative approach delves into causal relationships between these factors and financial performance outcomes, elucidating specific dynamics influencing SHPs in Nepal. The study's population comprises the entire workforce of 53 SHPs in Nepal, while the sample size of 200 respondents, drawn from various stakeholders, is deemed sufficient for capturing diverse perspectives. Data collection will utilize a questionnaire survey technique with a Likert scale, ensuring the collection of reliable quantitative data directly from stakeholders within the hydropower and electricity sector. This methodological framework, drawing on primary data sources and employing a structured questionnaire instrument, is designed to facilitate a comprehensive analysis of the factors affecting the financial performance of SHPs in Nepal.

The data collected for this study underwent meticulous organization and analysis using statistical software packages such as Microsoft Excel and SPSS. Various statistical tools including descriptive statistics, correlation analysis, and multivariate regression modeling

were employed to scrutinize the dataset, aiming to reveal insights, relationships, and patterns regarding the factors influencing the financial performance of small hydropower projects in Nepal. The research framework has been developed by delineating the relationships between the dependent variable, financial performance (FP), and independent variables including project-related factors (PR), contractual relationship (CR), client-related factors (CLR), consultant-related factors (CONS), and external environment (EE). Leveraging this established framework facilitated a systematic evaluation of how these variables interact and impact the financial performance of small hydropower projects in Nepal, ensuring consistency and rigor in the analysis process.

Overall, the study concludes that client-related factors and consultant-related factors are the main determinants of the financial performance of Small Hydropower Projects in Nepal. The strong and significant positive impact of these factors highlights their crucial role in enhancing financial outcomes. On the other hand, project-related factors, the external environment, and contractual relationships exhibit weaker and statistically insignificant impacts, indicating that they are less influential in determining financial performance. Thus, while improvements in client and consultant-related aspects can significantly boost financial performance, other factors have a less pronounced or negligible impact. Overall, the independent variables examined in this study collectively contribute to financial performance, with client-related and consultant-related factors being the most influential.

This study presents both practical and theoretical implications. Practically, it emphasizes the critical role of client-related and consultant-related factors in enhancing the financial performance of Small Hydropower Projects in Nepal. Theoretically, it reinforces the significance of these factors within the broader context of project management and financial performance frameworks, while highlighting the relatively lesser impact of project-related factors, external environment, and contractual relationships. It is recommended that project stakeholders prioritize improvements in client and consultant-related aspects to boost financial outcomes. Enhancing communication, expertise, and collaboration between clients and consultants can lead to more successful project execution. Additionally, while project-related factors, external environment, and contractual relationships should not be neglected, their management should be aligned with the primary focus on client and consultant-related improvements.

5.2 Conclusion

The first objective of this study is to assess the current status of factors affecting the financial performance of Small Hydropower Projects in Nepal. The findings reveal that across various dimensions, including client-related, consultant-related, project-related, external environmental, contractual relationships, and financial performance, there is a consistent perception of moderate to medium to high importance attributed to each factor. Specifically, factors such as Client Related Factor (CLI), Consultant Related Factor (CNS), Project Related Factor (PRO), External Environment (EXT), and Contractual Relationship (CNR) all demonstrate a level of significance in the range of medium to medium-high, as indicated by their mean scores and standard deviations. Notably, External environment (FPR) emerges as the most critical factor, with the highest mean score, underscoring its paramount importance in determining the overall success of hydropower projects.

The second objective of this study is to examine the relationship between client-related factors, consultant-related factors, project-related factors, the external environment, contractual relationships, and the financial performance of Small Hydropower Projects in Nepal. The correlation analysis reveals strong positive correlations between financial performance and each of the independent variables: Client Related Factor (CLI), Consultant Related Factor (CNS), Project Related Factor (PRO), External Environment (EXT), and Contractual Relationship (CNR). These correlations are statistically significant at the 5% level, underscoring the importance of these factors in influencing financial performance. Specifically, as client-related, consultant-related, project-related, external environmental, and contractual relationship factors increase, financial performance tends to increase correspondingly. This highlights the interconnectedness and interdependence of various factors impacting the financial outcomes of small hydropower projects in Nepal.

The third objective of this study is to analyze the impact of client-related factors, consultant-related factors, project-related factors, the external environment, and contractual relationships on the financial performance of Small Hydropower Projects in Nepal, the regression model provides insightful results. Client-related factors show a moderate positive and significant impact on financial performance, indicating that improvements in client-related aspects can enhance financial outcomes. Consultant-related factors exhibit a strong and significant positive impact, underscoring their critical

role in boosting financial performance. Although project-related factors indicate a weak positive impact, their influence is not statistically significant, suggesting a marginal effect on financial performance. The external environment also shows a weak and statistically insignificant impact, highlighting that external factors may not substantially affect financial outcomes. Contractual relationships demonstrate an extremely weak and statistically insignificant impact, indicating minimal effect on financial performance. Overall, the analysis suggests that while client and consultant-related factors significantly enhance financial performance, project-related factors, the external environment, and contractual relationships have a less pronounced or negligible impact.

5.3 Implications

5.3.1 Theoretical Implications

The theoretical implications of this study lie in advancing our understanding of the factors influencing the financial performance of small hydropower projects in Nepal. By employing theoretical frameworks such as Prospect Theory, Goal-Setting Theory, Diffusion of Innovation Theory, and Agency Theory, this research provides insights into the cognitive, motivational, and organizational aspects shaping decision-making processes and outcomes in the context of hydropower development. Furthermore, the examination of small hydropower projects within the Sustainable Development Goals framework contributes to theoretical discussions on sustainability and renewable energy development, highlighting the role of such projects in achieving broader socio-economic and environmental objectives. The integration of these theories and frameworks enhances theoretical knowledge in energy economics, project management, and sustainable development, offering valuable insights for researchers and policymakers.

5.3.2 Practical Implications

The practical implications of this study are significant for various stakeholders involved in the planning, development, and management of small hydropower projects in Nepal. By identifying and analyzing the factors influencing financial performance, this research offers actionable insights for project developers, investors, policymakers, and local communities. For project developers and investors, the findings can inform investment decisions, risk management strategies, and project planning processes, thereby improving project viability and profitability. Policymakers can use the insights to design more effective regulatory frameworks, incentives, and support mechanisms to promote

sustainable energy development and attract investment in the hydropower sector. Local communities stand to benefit from improved project planning and implementation, ensuring equitable distribution of benefits, environmental sustainability, and social responsibility. Overall, the practical implications underscore the importance of evidence-based decision-making and stakeholder collaboration in advancing the sustainable development of small hydropower projects in Nepal, ultimately contributing to the country's energy security, economic growth, and environmental sustainability.

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APPENDICES

Appendix I: Questionnaire

Dear Sir/Mam,

You have been selected as one of the respondents for a study on the "**Factors Affecting the Financial Performance of Small Hydropower Projects**" as part of my Master's degree dissertation at Shanker Dev Campus, Tribhuvan University. Your participation in this survey is entirely voluntary. Your honest and forthcoming responses are highly appreciated to ensure the thoroughness of my research. Please be assured that all your answers will be treated with confidentiality.

Completing the survey should take no more than 10 minutes at most. Detailed instructions are provided in each section of the survey.

Thank you for your cooperation.

Sincerely,

Binita Basnet,

Shanker Dev Campus,

Tribhuvan University

Please put a tick mark (✓) in the box in an appropriate option for each of the following.

1 Gender

- ☐ Male
- ☐ Female
- ☐ Others

2 Age Group (in years)

- ☐ Below 30
- ☐ 30 to 50
- ☐ 50 and Above

3 Academic Qualifications.

- ☐ SLC

- ☐ 10+2
- ☐ Bachelors
- ☐ Masters and above

4 Designation

- ☐ Employee
- ☐ Consultant
- ☐ Developer
- ☐ Contractor

Please only tick mark (✓)in each statement that you feel the statement is important for affecting the financial performance of small hydropower projects.

Very Low Important	Low Important	Medium Important	High Important	Very High Important
1	2	3	4	5

S.N.	**Statements**	**Scoring**				
	Project characteristics related factors	**1**	**2**	**3**	**4**	**5**
1	Size of project					
2	Complexity of project					
3	Completion period given for the contractor					
4	Skillful workers Availability					
5	Quality control of materials					
6	material prices fluctuation					
7	Supply of materials					
	Contractual Relationship	**1**	**2**	**3**	**4**	**5**
1	Communication system among project participants					
2	Feedback capabilities between project participants					
3	Control mechanism of the project activities					
4	Overall management actions					
5	safety, quality assurance program					
6	Unrealistic construction time					
7	Late delivery of material					
	External Environments	**1**	**2**	**3**	**4**	**5**

1	Economic environment					
2	Social environment					
3	Political environment					
4	Physical environment					
5	Advanced Technology					
6	Cold / hot climate					
7	Monsoon					
8	Blockade and strike					
9	Extra space not available at site					
	Client Related Factors	**1**	**2**	**3**	**4**	**5**
1	Client's experience in Hydropower					
2	Size of organization					
3	emphasis on low construction cost					
4	emphasis on quick construction instead of quality					
5	ability to make project decisions					
6	ability to brief the project objectives					
7	interference during construction					
8	Non-capable representative					
9	Delay of progress payment to contractors					
10	Land acquisition					
11	Demand of local people					
	Consultant Related Factors	**1**	**2**	**3**	**4**	**5**
1	Consultants' commitment					
2	involvement to monitor the project progress					
3	cooperation to solve problems					
4	Adequacy of design and specification					
5	Lack of experience in hydropower					
6	Delay in decision making					
7	Delay in material approving					
8	Late issue of drawings					
9	Incomplete drawings					
10	Dispute with contractor					

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

	Financial Performance	**1**	**2**	**3**	**4**	**5**
1	I believe that revenue measures the financial performance of small hydropower projects.					
2	I believe that net present value measures the financial performance of small hydropower projects.					
3	I believe that the internal rate of return measures the financial performance of small hydropower projects.					
4	I believe that return on equity measures the financial performance of small hydropower projects.					
5	I believe that return on assets measures the financial performance of small hydropower projects.					
6	I believe that the payback period measures the financial performance of small hydropower projects.					
6	I believe that operating expenses measure the financial performance of small hydropower projects.					
7	I believe that debt service coverage measures the financial performance of small hydropower projects.					
7	I believe that the cost of sales measures the financial performance of small hydropower projects.					
8	I believe that the net profit margin measures the financial performance of small hydropower projects.					
9	I believe that financial leverage measures the financial performance of small hydropower projects.					

Appendix II: Frequency Table

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	113	56.5	56.5	56.5
	Female	87	43.5	43.5	100.0
	Total	200	100.0	100.0	

Age Group (in years)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Below 30	95	47.5	47.5	47.5
	30 to 50	85	42.5	42.5	90.0
	50 and above	20	10.0	10.0	100.0
	Total	200	100.0	100.0	

Academic Qualifications

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SLC	26	13.0	13.0	13.0
	10+2	33	16.5	16.5	29.5
	Bachelors	88	44.0	44.0	73.5
	Masters or above	53	26.5	26.5	100.0
	Total	200	100.0	100.0	

Designation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Employee	98	49.0	49.0	49.0
	Consultant	30	15.0	15.0	64.0
	Developer	22	11.0	11.0	75.0
	Contractor	50	25.0	25.0	100.0
	Total	200	100.0	100.0	

Appendix III: Descriptive Statistics

Descriptive Statistics

	N	Mean	Std. Deviation
Client's experience in Hydropower	200	3.72	1.067
Size of organization	200	3.62	1.078
emphasis on low construction cost	200	3.60	1.084
emphasis on quick construction instead of quality	200	3.60	1.076
ability to make project decisions	200	3.62	1.115
ability to brief the project objectives	200	3.52	1.139
interference during construction	200	3.56	1.110
Non-capable representative	200	3.65	1.129
Delay of progress payment to contractors	200	3.50	1.147
Land acquisition	200	3.46	1.227
Demand of local people	200	3.60	1.099
Consultants commitment	200	3.54	1.168
involvement to monitor the project progress	200	3.62	1.124
cooperation to solve problems	200	3.50	1.147
Adequacy of design and specification	200	3.71	1.011
Lack of experience in hydropower	200	3.64	1.098
Delay in decision making	200	3.57	1.180
Delay in material approving	200	3.48	1.156
Late issue of drawings	200	3.68	1.084
Incomplete drawings	200	3.54	1.116
Dispute with contractor	200	3.5950	1.14785
Size of project	200	3.3000	1.11184
Complexity of project	200	3.5250	1.15588
Completion period given for the contractor	200	3.6050	0.98684
Skillful workers Availability	200	3.4600	1.21482
Quality control of materials	200	3.5300	1.10690
material prices fluctuation	200	3.6300	1.09961
Supply of materials	200	3.5750	1.11381
Economic environment	200	3.5350	1.18567
Social environment	200	3.6550	1.10092
Political environment	200	3.5850	1.11760
Physical environment	200	3.6650	1.10402
Advanced Technology	200	3.6550	1.12798
Cold / hot climate	200	3.6250	1.11831
Monsoon	200	3.6300	1.13115
Blockade and strike	200	3.6250	1.10475
Extra space not available at site	200	3.5900	1.07128
Communication system among project participants	200	3.7050	1.06473
Feedback capabilities between project participants	200	3.5350	1.15126

Control mechanism of the project activities	200	3.5550	1.15918
Overall management actions	200	3.6500	1.14194
safety, quality assurance program	200	3.5450	1.11092
Unrealistic construction time	200	3.4950	1.16048
Late delivery of material	200	3.5800	1.17922
I believe that revenue measures the financial performance of small hydropower projects.	200	3.5350	1.13367
I believe that net present value measures the financial performance of small hydropower projects.	200	3.6850	1.02520
I believe that the internal rate of return measures the financial performance of small hydropower projects.	200	3.5450	1.11993
I believe that return on equity measures the financial performance of small hydropower projects.	200	3.8400	0.99970
I believe that return on assets measures the financial performance of small hydropower projects.	200	3.6950	1.12172
I believe that the payback period measures the financial performance of small hydropower projects.	200	3.5350	1.19411
I believe that operating expenses measure the financial performance of small hydropower projects.	200	3.6350	1.14820
I believe that debt service coverage measures the financial performance of small hydropower projects.	200	3.6950	1.16566
I believe that the cost of sales measures the financial performance of small hydropower projects.	200	3.6900	1.08619
I believe that the net profit margin measures the financial performance of small hydropower projects.	200	3.6700	1.13912
I believe that financial leverage measures the financial performance of small hydropower projects.	200	3.6400	1.11202
CLI	200	3.5832	0.68088
CNS	200	3.5855	0.68680
PRO	200	3.5178	0.71172
EXT	200	3.6183	0.68262
CNR	200	3.5809	0.71736
FPR	200	3.6513	0.69210
Valid N (listwise)	200		

Appendix IV: Correlation Analysis

Correlations

		CLI	CNS	PRO	EXT	CNR	FPR
CLI	Pearson Correlation	1	.740**	.652**	.694**	.629**	.706**
	Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.000
	N	200	200	200	200	200	200
CNS	Pearson Correlation	.740**	1	.624**	.739**	.692**	.775**
	Sig. (2-tailed)	0.000		0.000	0.000	0.000	0.000
	N	200	200	200	200	200	200
PRO	Pearson Correlation	.652**	.624**	1	.604**	.671**	.603**
	Sig. (2-tailed)	0.000	0.000		0.000	0.000	0.000
	N	200	200	200	200	200	200
EXT	Pearson Correlation	.694**	.739**	.604**	1	.619**	.647**
	Sig. (2-tailed)	0.000	0.000	0.000		0.000	0.000
	N	200	200	200	200	200	200
CNR	Pearson Correlation	.629**	.692**	.671**	.619**	1	.596**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000		0.000
	N	200	200	200	200	200	200
FPR	Pearson Correlation	.706**	.775**	.603**	.647**	.596**	1
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	
	N	200	200	200	200	200	200

**. Correlation is significant at the 0.01 level (2-tailed).

Appendix V: Regression Analysis

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.805[a]	0.648	0.638	0.41614

a. Predictors: (Constant), CNR, EXT, PRO, CLI, CNS

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	61.728	5	12.346	71.291	.000[b]
	Residual	33.595	194	0.173		
	Total	95.323	199			

a. Dependent Variable: FPR

b. Predictors: (Constant), CNR, EXT, PRO, CLI, CNS

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	0.446	0.180		2.477	0.014		
	CLI	0.231	0.072	0.228	3.232	0.001	0.366	2.734
	CNS	0.499	0.077	0.495	6.494	0.000	0.313	3.194
	PRO	0.109	0.062	0.112	1.758	0.080	0.450	2.225
	EXT	0.056	0.069	0.056	0.813	0.417	0.390	2.565
	CNR	0.001	0.064	0.001	0.010	0.992	0.418	2.391

a. Dependent Variable: FPR

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ABSTRACT This study examines the financial performance of small hydropower projects in Nepal, focusing on the impact of various factors such as client-related, consultant-related, project- related, external environment, and contractual relationships. The objective is to identify and analyze these factors to provide insights into the financial viability and profitability of such projects, particularly given Nepal's reliance on hydropower and the global push for sustainable energy. The research design combines descriptive statistics and causal-comparative analysis to evaluate the impact of the aforementioned factors on financial performance. The population includes the workforce of 53 small hydropower projects in Nepal, with a sample size of 200 respondents from various stakeholders. Data collection was conducted using a structured questionnaire survey with a Likert scale to gather reliable quantitative data from the hydropower and electricity sector stakeholders. The data was meticulously analyzed using Microsoft Excel and SPSS, employing statistical tools such as descriptive statistics, correlation analysis, and multivariate regression modeling. The research framework established relationships between the dependent variable, financial performance, and independent variables including project-related factors, contractual relationships, client- related factors, consultant-related factors, and the external environment. The results indicate that client-related and consultant-related factors have a strong and significant positive impact on financial performance, underscoring