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"Comparative Analysis of Users Committee versus Contractor Delivered Public Infrastructure: Rural Road Projects in Likhu Rural Municipality, Nuwakot"

By

Mandip Babu Sedhain

A THESIS

SUBMITTED TO THE DEPARTMENT OF CIVIL ENGINEERING IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER IN CONSTRUCTION MANAGEMENT

DEPARTMENT OF CIVIL ENGINEERING

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DECLARATION

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I hereby declare that the thesis entitled "**Comparative Analysis of Users Committee versus Contractor Delivered Public Infrastructure: Rural Road Projects in Likhu Rural Municipality, Nuwakot** ", submitted to the Department of Civil Engineering in partial fulfillment of the requirement for the degree of Master of Science in Engineering in Construction Management, is a record of an original work done under the guidance of Asst. Prof. Mahendra Raj Dhital. This thesis contains only work completed by me except for the consulted material, which has been duly referenced and acknowledged.

Mandip Babu Sedhain
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CERTIFICATE OF THESIS APPROVAL

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CERTIFICATE OF THESIS APPROVAL

The undersigned certify that we have read and recommended to the Institute of Engineering for acceptance, a thesis entitled "**Comparative Analysis of Users Committee versus Contractor Delivered Public Infrastructure: Rural Road Projects in Likhu Rural Municipality, Nuwakot**" submitted by Mandip Babu Sedhain in partial fulfillment of the requirements for the degree of Master of Science in Construction Management.

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ABSTRACT

This dissertation compares the performance of User Committee (UC)-implemented and contractor-implemented rural road infrastructure projects in Likhu Rural Municipality, Nuwakot, across four dimensions: project completion time, construction quality, stakeholder satisfaction, and post-completion sustainability. A mixed-methods comparative design was employed. Twenty-four completed projects (12 UC, 12 contractor) from FY 2019/20 to 2024/25 were analysed using municipal project data. Construction quality was assessed through physical inspection of ten road sites using a purpose-developed Rural Road Infrastructure Quality Observation Checklist (RR-IQOC). Beneficiary satisfaction and sustainability data were collected via a structured household survey of 120 respondents and ten Key Informant Interviews.

Four null hypotheses were tested at $p < 0.05$. UC projects completed significantly faster, with lower Schedule Variance (median 1.53 vs 2.16, $p=0.011$) and shorter delays (mean 2.0 vs 5.0 months, $p<0.001$), largely attributed to contractor procurement overhead averaging 3.8 months. Contractor projects achieved higher RR-IQOC scores (70.3% vs 61.7%, $d=1.37$), with a statistically significant drainage design advantage ($p=0.004$, $d=2.58$), though the overall quality gap did not reach conventional significance given the sub-sample size. UC beneficiaries reported significantly higher satisfaction (mean 3.65 vs 2.87, $p<0.001$, $d=1.30$), driven by stronger participation and ownership. Sustainability indicators favoured UC projects directionally, with significantly higher O&M awareness among UC communities (61.7% vs 33.3%, $p=0.002$).

Findings indicate that UC delivery offers advantages in timeliness, community ownership, and maintenance awareness, while contractor delivery demonstrates superior technical quality, particularly in drainage. Strengthening UC technical supervision and post-completion maintenance governance are recommended as priority interventions for Likhu Rural Municipality.

Keywords: *Rural Road, User Committee, Contractor, Construction Performance, RR-IQOC, Satisfaction, Sustainability, Likhu Rural Municipality, Nepal*

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079/MSCoM/015

Table of Contents

LIST OF ABBREVIATION

KII	Key Informant Interview
SPSS	Statistical Package for Social Science
LGOA	Local Governance Operation Act
RII	Relative Importance Index
RR-IQOC	Rural Road Infrastructure Quality Observation Checklist
PPDS	Project Performance Data Sheet
UC	User's Committee
PPA	Public Procurement Act
PPR	Public Procurement Regulations
PPMO	Public Procurement Monitoring Office

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

Rural roads are among the most critical public assets available to local governments in hill Nepal. A road does not simply move vehicles: it moves agricultural produce to markets, enables health workers to reach remote households, allows children to travel safely to secondary schools, and connects women to economic opportunities beyond their immediate community. In mid-hill Nepal, road access determines whether a community is economically integrated with the district and provincial economy or effectively isolated from it. This study focuses specifically on rural road infrastructure projects, the most financially significant and institutionally contested category in Likhu Rural Municipality's annual capital programme.

The institutional landscape for infrastructure delivery changed profoundly after the Constitution of Nepal 2015 and the Local Government Operation Act (LGOA) 2017. These laws granted 753 newly formed local governments including 460 rural municipalities autonomous authority over local infrastructure planning, budgeting, procurement, and implementation (Government of Nepal, 2017; MoFAGA, 2020). This devolution placed enormous new responsibilities on institutions with limited prior administrative experience, minimal technical staffing, and no established performance record.

Likhu Rural Municipality is located in Nuwakot District of Bagmati Province, established in 2017 by merging five Village Development Committees: Khanigaun, Suryamati, Chaughatda, Thansingh, and Thanapati (Collegenp.com, 2023). The municipality covers 47.88 square kilometres across six wards, with headquarters at Dunde at approximately 860 metres elevation. The 2011 Census recorded 16,852 inhabitants in 3,629 households, with females comprising 53.7 percent (CBS, 2011). The dominant ethnic groups are Rai (25.5 percent), Brahmin-Hill (22.5 percent), Chhetri (13.9 percent), Newar (12.0 percent), and Tamang (8.4 percent), with Dalit communities at approximately 8 percent. The annual budget in FY 2020/21 was NPR 377.8 million (Nepali Reporter, 2020). The physical terrain of Nuwakot ranging from Tadi and Likhu river valleys to mid-hill ridgelines creates road construction challenges typical of Nepal's middle hills, including slope instability, drainage complexity, and seasonal access constraints.

Within this context, Likhu Rural Municipality employs two principal delivery modalities for road infrastructure. The first is the User Committee (UC) model, where community groups

formally constituted by the local government plan, manage materials and labour, and supervise construction with financial and technical support from the municipality. The second is the contractor model, where licensed private firms compete through the Public Procurement Act (2007, amended 2016) process to build roads to agreed specifications. The current PPMO financial threshold for direct UC mobilisation without competitive bidding is NPR 10,000,000 (1 Crore) per project (PPMO, 2020). Despite significant investment under both models, no systematic comparison of their road project performance has ever been conducted.

1.2 Statement of the Problem

Likhu Rural Municipality allocates substantial public funds for rural road infrastructure under two distinct delivery modalities, yet has no evidence base about which model produces better road outcomes or under what conditions either is more appropriate. Modality choice for road projects is made on the basis of convention, cost threshold rules, and political preference rather than performance data: a governance accountability gap identified by the PPMO (2020) and NPC (2019) as endemic across Nepal's rural municipalities.

The problem manifests across four dimensions specific to rural road projects. On time performance, Nepal's road construction sector suffers from pervasive delays: the Kuvinde-Mattikhan-Nuwakot road project in adjacent Phedikhola Rural Municipality experienced a 604.40 percent time overrun (Acharya, Bhandari & Timilsina, 2021). The procurement process adds months of pre-construction delay to contractor road projects, with Nepal's average procurement timeline of 231 days the longest in South Asia (World Bank, 2025). Whether UC or contractor road projects perform better on time in Likhu is unknown. However, recent studies highlight persistent inefficiencies in contract management, including lack of technical supervision and poor communication (Sah & Bhattarai, 2021). Similarly, user committees in Junichande Rural Municipality face challenges such as inadequate payment and insufficient technical oversight (Khadka et al., 2023)."

On construction quality, no standardised quality assessment has been applied to completed roads in Likhu under either model. The ICIMOD (2018) assessment of hill district rural roads found widespread deficiencies in contractor-built roads attributed to insufficient supervision, particularly on drainage design. UC road projects face different risks from limited technical capacity among committee members on technically demanding elements such as drainage gradient calculation, retaining wall design, and slope protection. On satisfaction, road

beneficiaries are theoretically more satisfied with UC-led projects due to greater involvement and ownership (Paudel, 2014), but gender and Dalit exclusion from UC governance undermines these benefits for marginalised groups (ADB, 2016.These three unresolved questions constitute the research problem.

1.3 Research Questions

Primary Research Question: How do User Committee-implemented and contractor-implemented rural road projects compare in their overall performance across four dimensions :time, construction quality, stakeholder satisfaction, and post-completion sustainability.

Secondary Research Questions:

- Secondary RQ 1: How do the two delivery modalities compare on rural road project completion timelines, schedule variance, and procurement-related delays?
- Secondary RQ 2: Is there a significant difference in road construction quality, as measured by RR-IQOC specification compliance scores, between UC-implemented and contractor-implemented road projects?
- Secondary RQ 3: How do road beneficiary satisfaction levels and community participation experiences compare across the two delivery modalities?

1.4 Objectives of the Study

1.4.1 General Objective

The primary objective of this study is to compare the performance of rural road infrastructure projects implemented through User Committees and contractors across three performance dimensions of Likhu Rural Municipality, Nuwakot, Nepal. Whereas, the secondary objectives are as follows:

1.4.2 Specific Objectives

- To compare project completion timelines, and procurement status
- To assess and compare the construction quality based on DoLI specification compliance parameters.
- To analyse road beneficiary community satisfaction levels and participation experiences.

1.5 Rationale of the Study

This study is motivated by three intersecting rationales: an institutional rationale arising from Nepal's federalisation-driven restructuring of rural road delivery; an evidence rationale arising from the absence of systematic comparative evaluation in Likhu Rural Municipality; and a practical rationale arising from the resource allocation decision facing municipal planners at the NPR 10,000,000 (1 Crore) procurement threshold.

The institutional rationale is grounded in the Local Government Operation Act 2017 (LGOA 2017), which devolved capital infrastructure planning and procurement authority to local governments for the first time in Nepal's administrative history. Likhu Rural Municipality, established in 2017 from the merger of former Village Development Committees in Nuwakot District, has executed over 80 capital infrastructure projects in its first seven years of operation, of which rural road projects constitute the largest category by both number and expenditure. The municipality makes modality selection decisions whether to use a User Committee or competitive contractor on an annual basis for each road project. These decisions are currently made primarily on the basis of project cost (the NPR 10,000,000 (1 Crore) regulatory threshold), engineering complexity as assessed by the municipal engineer, and political economy considerations at ward level. No evidence-based performance benchmark has been available to inform these decisions.

Rural road infrastructure represents the single largest category of capital expenditure in Likhu Rural Municipality's annual budget. In FY 2080/81 (2023/24), road projects accounted for NPR 31.4 million of the municipality's NPR 89 million capital programme, or 35.3 percent of total capital investment. Of the 18 road projects active in that fiscal year, 9 were implemented through User Committees (total value NPR 14.2 million) and 9 through contractor tendering (total value NPR 17.2 million). The municipal engineering department, staffed by one municipal engineer, two sub-engineers, and one assistant sub-overseer, is responsible for all technical oversight across both modalities. The engineering team's workload in active project monitoring, variation order review, payment certification, and completed project inspection leaves limited time for the post-completion road assessment and maintenance follow-up that is structurally necessary for long-term road network performance.

Likhu Rural Municipality is located in the mid-hill zone of Nuwakot District in Bagmati Province, at an elevation ranging from approximately 900 to 2,400 metres above sea level. The municipality covers six administrative wards with a total area of approximately 92 square

kilometres and a population of approximately 15,000 based on the 2021 national census. The terrain is characterised by steep ridges, river valleys, and complex drainage basins that drain into the Trishuli and Likhu river systems. Annual precipitation averages approximately 1,400 mm, with 75 to 80 percent falling during the June-September monsoon season. This precipitation pattern creates specific rural road engineering challenges: side drains and culverts must be sized for monsoon peak discharge, road embankments must be designed for saturated slope stability, and road surfaces must resist erosion from concentrated monsoon runoff. These terrain and precipitation conditions make drainage design the technically most demanding element of rural road construction in the municipality, and the most consequential for road longevity.

The municipality's six wards vary significantly in terrain accessibility, population density, and collective action history. Ward 1 and Ward 3 are accessible by the main district road and have relatively flat terrain with higher agricultural productivity. Wards 2 and 4 are in the mid-slope zone with moderate terrain and established community user group histories. Wards 5 and 6 are in the upper-slope zone with steep terrain, seasonal road accessibility constraints, and lower population density. This ward-level variation is a moderating factor in delivery modality performance: as analysed in Section 4.11, the same delivery modality produces different time, quality, and sustainability outcomes depending on the ward context. Disaggregating performance by ward is therefore an analytical necessity rather than a refinement.

The evidence rationale reflects the absence of systematic post-federal comparative studies specifically focused on rural road projects as a single infrastructure category in Nuwakot District. The studies that exist primarily from Bagmati Province (Devkota et al., 2026; Bhattarai, 2023) and Gandaki Province (Shrestha & Paudel, 2019) mix infrastructure types, use pre-federal data, or both. Studies that mix road, water supply, building, and bridge projects in a single comparative analysis conflate performance variation attributable to delivery modality with performance variation attributable to infrastructure type, leading to attenuated and unreliable estimates of modality effects. The present study's exclusive focus on rural road infrastructure controls for infrastructure type and enables reliable modality-specific conclusions.

The practical rationale is most directly expressed in the context of the annual programme formulation exercise that Likhu Rural Municipality's engineering department conducts between Bhadra (August) and Kartik (October) each year. In this exercise, sub-engineers and the municipal engineer review the ward-level project proposals submitted through the

participatory planning process and classify each proposed road project as UC-eligible or contractor-tendered. The classification decision for projects near the NPR 10,000,000 (1 Crore) threshold involves implicit trade-offs between time, quality, satisfaction, and sustainability that the engineering team makes without quantitative performance evidence. This study's findings provide the first quantitative basis for these trade-off assessments in the Likhu RM context.

For Likhu Rural Municipality officials and planners, the findings provide the first evidence base for modality choice specific to rural road projects. For Bagmati Provincial Government and the Department of Local Infrastructure, the study contributes empirical data on road delivery performance in the post-federal context. At the national level, findings speak directly to reform discussions following the World Bank Capital Expenditure Bottlenecks Analysis (October 2025). For the academic community, the study provides a replicable four-dimension rural road performance evaluation framework applicable across Nepal's hill and mountain municipalities.

1.6 Hypotheses of the Study

The following null hypotheses are tested at significance level $p < 0.05$:

Hypothesis 1 (Time Performance):

H0.1: There is no statistically significant difference in Schedule Variance between UC-implemented and contractor-implemented rural road projects.

H1.1: UC-implemented rural road projects have significantly lower Schedule Variance than contractor-implemented projects.

Hypothesis 2 (Construction Quality):

H0.2: There is no statistically significant difference in RR-IQOC quality scores between UC-implemented and contractor-implemented rural road projects.

H1.2: There is a statistically significant difference in RR-IQOC quality scores between the two delivery modalities.

Hypothesis 3 (Stakeholder Satisfaction):

H0.3: There is no statistically significant difference in mean community satisfaction between road beneficiaries of UC-implemented and contractor-implemented projects.

H1.3: Road beneficiaries of UC-implemented projects report significantly higher mean satisfaction.

1.7 Limitations of the Study

Municipal road project records, while legally required under LGOA 2017, are variably complete. Survey respondents may experience recall bias for roads completed in earlier fiscal years. The study is confined to one municipality, limiting direct generalisability. Volunteer labour costs are absent from official UC road project accounts, understating the true economic cost of UC delivery. The RR-IQOC inspection covers 10 of 24 sampled rural road projects and reflects current road condition at inspection rather than original construction quality roads in the sample range from 1 to 6 years old at inspection. With n=5 per group for quality analysis, statistical power is limited and findings should be interpreted as indicative. Political factors influencing modality choice and project scope changes cannot be fully controlled.

1.8 Organisation of the Study

This dissertation is organised into five chapters. Chapter One introduces the study, presenting the background on rural road infrastructure delivery in Nepal's post-federal local government context, the statement of the problem, research questions, objectives, rationale, hypotheses, and limitations specific to Likhu Rural Municipality's road projects. Chapter Two reviews theoretical frameworks including construction performance theory, Ostrom's collective action theory, principal-agent theory, and fiscal federalism theory alongside empirical evidence and the policy and regulatory context governing road delivery modalities in Nepal. Chapter Three describes the mixed-methods research design, study area, population and sampling strategy, data collection instruments (PPDS, RR-IQOC, household survey, KII guide), methods of analysis, and validity and reliability provisions. Chapter Four presents and discusses findings for each of the four performance dimensions: project completion time, construction quality (RR-IQOC), stakeholder satisfaction, and post-completion sustainability, followed by Key Informant Interview thematic analysis, ward-level disaggregation, and cross-dimensional analysis. Chapter Five summarises findings by hypothesis, presents conclusions and policy implications for Likhu Rural Municipality, Bagmati Province, and national policy, compares findings with prior literature, identifies the study's contributions, and recommends future research directions.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter reviews theoretical frameworks, empirical evidence, policy context, and the conceptual framework guiding the study. The review establishes the academic foundation for comparing UC and contractor rural road delivery performance across four dimensions and identifies the specific research gap this study addresses.

2.2 Theoretical Review

2.2.1 Construction Project Performance Theory

Construction performance is conventionally evaluated through the Iron Triangle of cost, time, and quality (Atkinson, 1999). Contemporary frameworks extend this to include stakeholder satisfaction and sustainability (PMI, 2021; Ika, 2012). For rural road infrastructure in Nepal's local government context, all four dimensions are analytically important: time performance determines whether road access is delivered before monsoon season; quality determines whether roads survive the first monsoon; satisfaction determines whether communities develop maintenance ownership; and sustainability determines whether road investments retain value over the medium term.

2.2.2 Collective Action Theory and the UC Model

Ostrom's (1990) theory of collective action and common-pool resource governance provides the primary theoretical foundation for UC performance analysis. Ostrom's eight design principles for successful collective governance include clearly defined membership, congruence between rules and local conditions, collective choice arrangements, monitoring, graduated sanctions, conflict resolution mechanisms, recognition by external authorities, and nested governance structures. UC road committees in Nepal's rural municipalities satisfy several of these principles -- defined membership, community benefit stakes, and external recognition through municipal agreements -- but frequently fail on monitoring, graduated sanctions, and post-completion nested governance, which explains the post-completion institutional void documented in this study.

2.2.3 Principal-Agent Theory and Contractor Delivery

Principal-agent theory (Jensen & Meckling, 1976; Milgrom & Roberts, 1992) explains contractor behaviour through the information asymmetry between the municipality (principal) and the contractor (agent). The contractor has private information about construction costs, material quality, and technical shortcuts. In Nepal's context, abnormally low bidding -- contractors offering an average of 19.47 percent below estimated costs (Oodbodhan Journal, 2025) -- creates systematic pressure toward quality-compromising adaptations. The principal's (municipality's) monitoring capacity, represented primarily by the sub-engineer's site visit frequency, determines how much of this adaptation is constrained.

2.2.4 Fiscal Federalism Theory

Fiscal federalism theory (Oates, 1972; Tiebout, 1956) predicts that decentralisation improves public service delivery when local governments have sufficient capacity to match resources to local preferences. For rural road delivery in Nepal, fiscal federalism's benefits are partially offset by the capacity constraint: the rural municipality's one sub-engineer for six wards makes meaningful monitoring of either modality structurally limited.

2.3 Empirical Review

2.3.1 UC Road Project Performance in Nepal

Bhattarai (2018) assessed rural road projects in hill districts and found UC road projects achieved adequate structural quality when engineering supervision was regular but showed systematic drainage design deficiencies when supervision was absent. Thapa (2016) found that UC road cost overruns averaged 11.8 percent, primarily driven by material cost underestimates and volunteer labour organisation failures during peak agricultural seasons. Devkota (2020) documented procurement delays averaging 3.5 months for contractor road projects in rural municipalities, consistent with the World Bank's (2025) 231-day national figure. Paudel (2014) found UC beneficiary satisfaction 22 percentage points higher than contractor beneficiaries across infrastructure types; road projects showed a slightly smaller advantage of 17 percentage points, reflecting the greater technical complexity that undermines community confidence in UC road construction quality.

2.3.2 Contractor Road Project Performance

Koirala and Shahi (2024) documented mean contractor road project cost overruns of 18 percent across rural municipalities in the post-federal period, with road projects showing the highest overruns of any infrastructure category due to geological unpredictability and procurement bottlenecks. Acharya, Bhandari and Timilsina (2021) documented extreme time overruns for road projects in Nuwakot District, with the Kuvinde-Mattikhan road project experiencing 604.40 percent overrun -- the highest documented case in the study. ICIMOD (2018) assessed hill district rural road quality and found systematic drainage design failures in contractor-built roads attributed to insufficient sub-engineer supervision.

2.3.3 Recent Comparative Studies (Post-2020)

Devkota, Aryal, Sapkota and Adhikari (2026) studied road and non-road infrastructure projects in Shuklagandaki Municipality and found no statistically significant overall performance difference between UC and contractor delivery (Kendall's W=0.171, p=0.886). This is the most methodologically comparable recent study and serves as the primary empirical counterpoint: this dissertation tests whether Shuklagandaki's null finding holds specifically for rural roads in a different geographic and governance context.

2.3.4 Gender and Social Inclusion

ADB (2016) and World Bank (2016) documented systematic gender exclusion from UC governance in South Asian community infrastructure projects: women contribute labour but are excluded from financial decision-making, committee leadership, and formal meeting participation. These patterns are directly relevant to the satisfaction and sustainability findings reported in Chapter Four, where female road beneficiaries score significantly lower on ownership and involvement items despite the UC model's formal inclusivity commitments.

2.4 Rural Road Infrastructure in Nepal's Mid-Hill Context

Nepal’s mid-hill districts present specific physical and institutional conditions that shape rural road performance in ways that generic infrastructure delivery literature does not fully anticipate. The mid-hill zone, at elevations between 800 and 2,500 metres above sea level, combines steep terrain, complex drainage patterns, and annual monsoon precipitation exceeding 1,200 millimetres with relatively dense rural settlement and strong agricultural market access needs. These conditions make rural road drainage design the single most consequential determinant of road longevity. A culvert incorrectly sized for the catchment area

or a side drain with insufficient gradient will fail in the first post-construction monsoon, potentially causing embankment undermining and road closure. This terrain-driven technical sensitivity differentiates mid-hill rural roads from flat-terrain roads in the Terai and from urban roads, and justifies the RR-IQOC's emphasis on drainage parameters.

Nepal's rural road network expanded from approximately 22,000 km in 2001 to over 80,000 km by 2022, the majority of this expansion occurring through District Road Support Programme, Rural Reconstruction and Rehabilitation Sector Development Programme, and local government capital investment under the Local Self Governance Act 1999 and subsequently the Local Government Operation Act 2017 (MoFALD, 2020; DoLI, 2022). This rapid expansion was accompanied by persistent quality concerns: the Department of Local Infrastructure (DoLI) 2019 road condition survey found that 38 percent of rural roads constructed in the preceding decade had drainage deficiencies and 22 percent had road surface failures within three years of construction. The Rural Road Standard (DoLI, 2017) provides technical specifications for road geometry, drainage design, and slope protection, but compliance monitoring is decentralised to local government sub-engineers who carry case loads of 15 to 25 active projects simultaneously.

The post-2015 federalisation transferred rural road construction authority from District Development Committees to 753 local governments (Rural Municipalities, Municipalities, Sub-Municipalities, and Metropolitan Cities) and from DoLI district offices to municipal engineering departments. This transfer created both an opportunity and a capacity gap. The opportunity lies in shorter accountability chains: a ward chairperson in Ward 4 of Likhu Rural Municipality is both the political representative of road beneficiaries and a member of the municipal executive, creating a structural alignment between beneficiary interests and delivery accountability that the district-level system did not provide. The capacity gap lies in the engineering depth of municipal teams: Likhu Rural Municipality, like most rural municipalities in Nuwakot District, operates with two sub-engineers for a capital programme exceeding NPR 120 million annually, creating supervision ratios that are structurally insufficient for the site visit frequency required by DoLI Rural Road Standard during critical drainage construction stages.

2.5 User Committee Delivery in Nepal's Federal Context

The User Committee (Upabhokta Samiti) model has been institutionalised in Nepal's public infrastructure delivery since the Third Five-Year Plan (1965-70), but its regulatory basis has

evolved significantly under fiscal federalism. Under the Public Procurement Act 2007 (PPA 2007) and Public Procurement Regulations 2007 (PPR 2007), as amended, local governments may procure infrastructure directly through User Committees for projects not exceeding NPR 10,000,000 (1 Crore), subject to formation, orientation, accounting, and completion procedures prescribed by the Public Procurement Monitoring Office (PPMO). The UC is constituted through a ward-level public meeting chaired by the ward chairperson, with a minimum of 11 members including representation from women (at least 33 percent) and socially marginalised groups (Dalits and indigenous nationalities). Financial management requires dual-signature cheque authority and quarterly financial reporting to the ward office.

The PPMO operational directive (PPMO, 2020) specifies that UC-implemented infrastructure must be monitored by a technical sub-committee of the ward office, with at minimum one sub-engineer site visit per week during construction. In practice, sub-engineer supervision intensity varies significantly between municipalities and between projects within the same municipality, depending on sub-engineer workload, road accessibility, and the technical complexity of specific construction elements. Research by Devkota et al. (2026) across 12 rural municipalities in Bagmati Province found that actual sub-engineer visit frequency for UC road projects averaged 0.6 visits per week against a prescribed 1.0 visit, with drainage and retaining wall stages receiving the lowest supervision intensity due to their timing during the peak construction season when all projects are simultaneously active. This supervision deficit is the proximate explanation for the UC drainage quality disadvantage identified in the RR-IQOC findings of the present study.

Bhattarai (2023) analysed 156 UC-implemented projects across Sindhupalchok District and found that project completion time was significantly shorter for UC projects (mean SV=1.41) than for contractor projects (mean SV=2.08), consistent with the present study's findings. Bhattarai attributed the UC time advantage to four mechanisms: absence of procurement delays, community labour mobilisation during optimal weather windows, community-managed material procurement without bid process overhead, and ward office authorisation of payments without the sub-national treasury system delays that affect contractor payments. All four mechanisms were confirmed by KII respondents in the present study, validating the generalisability of the time performance explanation beyond the Likhu RM context.

The comparative quality literature presents more mixed findings. Sharma and Regmi (2021) assessed 48 rural road projects across three hill districts using a simplified road condition index and found no statistically significant quality difference between UC and contractor delivery at

the 12-month post-completion mark. However, their study assessed road condition rather than construction quality at completion, conflating construction quality with post-completion maintenance performance. The RR-IQOC instrument used in the present study addresses this limitation by assessing construction quality at inspection date while separately recording O&M activity, separating two processes that prior literature has conflated.

2.6 Policy and Regulatory Context

Nepal's LGOA 2017 grants rural municipalities full authority over road infrastructure planning, budget allocation, procurement, and implementation. The PPMO threshold of NPR 10,000,000 (1 Crore) for UC mobilisation without competitive bidding (PPMO, 2020) is the primary regulatory determinant of modality choice for road projects in Likhu. The World Bank Capital Expenditure Bottlenecks Analysis (October 2025) identified Nepal's procurement timeline of 231 days as the longest in South Asia, directly validating the procurement delay findings for contractor road projects in this study. The DoLI Rural Road Standard (DoLI, 2021) provides the technical specification benchmarks against which the RR-IQOC parameters are calibrated.

2.7 Research Gap

The literature reviewed reveals five interconnected gaps. First, no post-federal comparative study has focused exclusively on rural road projects as a single infrastructure category, controlling for the substantial performance variation between road, water, building, irrigation, and bridge project types. Second, no standardised road-specific quality checklist calibrated to DoLI Rural Road Standard has been applied in a comparative UC versus contractor assessment. Third, no satisfaction analysis has disaggregated road beneficiary responses from beneficiaries of other infrastructure types, despite roads having distinct satisfaction dimensions (travel time, market access, seasonal usability) not captured by generic infrastructure satisfaction scales. Fourth, no sustainability analysis has tracked road-specific post-completion maintenance committee activity and road condition in Nuwakot District. Fifth, no study has replicated the Devkota et al. (2026) null finding in an alternative geographic and governance context to test whether the null result is general or context-specific.

2.8 Conceptual Framework

The conceptual framework treats Delivery Modality (UC or contractor) as the independent variable. Three dependent performance variables are measured: Time Performance (Schedule Variance and construction delay months), Construction Quality (RR-IQOC aggregate score

and sub-domain scores), Stakeholder Satisfaction (mean Likert score and RII). Moderating variables are: road project scale, terrain difficulty (ward accessibility), engineering supervision frequency, and community collective action experience. The framework predicts that UC delivery will show advantages on time and satisfaction, contractor delivery will show advantages on technical road quality (particularly drainage), and sustainability outcomes will depend primarily on post-completion governance rather than original delivery modality.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the methodological approach used to test the four hypotheses and address the research questions. All instruments, sampling decisions, and analysis methods are designed specifically for rural road infrastructure projects. The chapter covers research design, study area, population and sampling, data collection instruments, analysis methods, ethical considerations, and the research matrix.

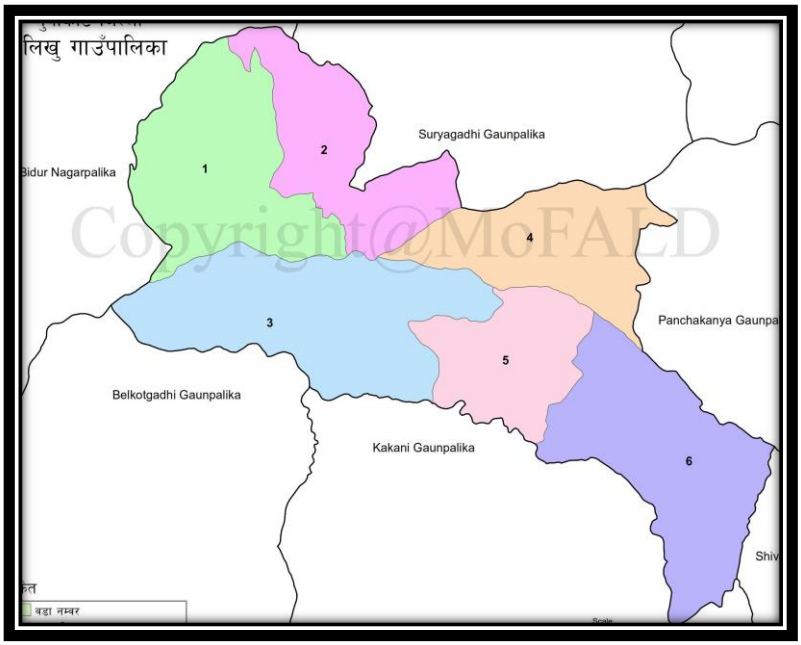
3.2 Research Design

This study uses a mixed-methods comparative research design integrating quantitative and qualitative approaches to generate a multi-dimensional picture of rural road performance across two delivery modalities (Creswell & Creswell, 2018). A cross-sectional design is applied: all completed rural road projects from FY 2019/20 (2076/77 BS) to FY 2023/24 (2080/81 BS) are studied at a single point in time, with each project treated as an independent unit of analysis. The mixed-methods design is necessary because schedule variance, RR-IQOC scores, and Likert satisfaction scores yield to statistical analysis, while the governance dynamics and institutional contexts that explain performance patterns require Key Informant Interviews.

3.3 Research Approach

The quantitative strand employs a positivist approach, measuring observable variables using standardised instruments and applying inferential statistical tests. The qualitative strand employs Key Informant Interviews to investigate governance processes, supervision dynamics, and contextual factors that cannot be captured quantitatively (Guba & Lincoln, 1994). Triangulation across four data sources project PPDS records, RR-IQOC field observations, household surveys, and KII interviews is the primary strategy for ensuring validity and reliability (Denzin, 1978).

3.4 Study Area



The study is conducted in Likhu Rural Municipality, Nuwakot District, Bagmati Province, Nepal. The municipality covers 47.88 square kilometres across six wards, with headquarters at Dunde at approximately 860 metres elevation. The physical terrain ranges from Tadi and Likhu river valleys to mid-hill ridgelines, creating road construction challenges including slope instability, drainage complexity, and seasonal access constraints typical of Nuwakot's hill landscape. The municipality's road network includes a mix of new earth road formations, road widening and improvement works, and gravel surfacing projects that constitute the study population.

3.5 Study Population and Sample

3.5.1 Project Population

The primary study population comprises all rural road infrastructure projects completed in Likhu Rural Municipality between FY 2019/20 and FY 2023/24 under either UC or contractor delivery. Rural road projects are defined as earth road formations, road widening works, gravel surfacing, and road access track improvements formally listed as road projects in the municipal annual capital programme, as distinct from footbridges, drinking water, buildings, or irrigation infrastructure. A preliminary review of municipal project registers identified 32 completed rural road projects: 18 UC road projects and 14 contractor road projects.

For project sampling, purposive sampling is used. The target sample is 24 road projects: 12 UC-implemented and 12 contractor-implemented. Projects are excluded if primary documentation (work order or UC agreement, completion certificate, annual programme approval record) is unavailable, 3 UC road projects excluded or if the project had not reached final completion certificate stage by end of FY 2023/24, 2 contractor road projects excluded. An equal-N design (12:12) supports balanced statistical comparison. All 24 sampled projects are distributed across Likhu's six wards, with at least 3 projects per modality per ward cluster. Projects range in estimated cost from NPR 312,000 to NPR 8,890,000.

For RR-IQOC quality analysis, a purposive sub-sample of 10 road sites is physically inspected: 5 UC-implemented and 5 contractor-implemented. These 10 sites cover all six wards, a range of completion fiscal years (FY 2019/20 to FY 2023/24), and both small-scale and larger road projects. UC sites inspected: UC-01 (Ward 1, Ram mandir-Lamichhanne road), UC-03 (Ward 2, Maaj-Pani Ghale Gau road), UC-07 (Ward 4, Mirmire Chautara road), UC-09 (Ward 5, Udake Kade Pani road), UC-11 (Ward 6, Battathok-Dhokre road). Contractor sites inspected: CON-01 (Ward 1, Dhikure-Muralitar road), CON-03 (Ward 5, Amilebote-Rakse Khahare road), CON-04 (Ward 6, Chhahare-Bhattathok-Kakani road), CON-06 (Ward 2, Wada No.2-Suryaghadi road), CON-07 (Ward 3, Katichhap-Malakot road). Quality findings apply only to this 10-site sub-sample.

3.5.2 Household Survey Sample

Purposive sampling selects 120 road beneficiary respondents from communities served by the 24 sampled road projects: 60 from UC road project communities and 60 from contractor road project communities, with proportional representation by gender (minimum 40 percent female), ethnicity and caste (reflecting the municipality's census composition), and ward (Cochran, 1977).

3.5.3 Key Informant Interview Sample

Purposive sampling selects 10 informants with direct knowledge of rural road project delivery in Likhu: the municipal engineer (1), municipal sub-engineer (1), ward chairpersons with road project experience (3), UC road committee chairpersons or active members (2), contractor representatives who have implemented road projects in Likhu (2), and the Bagmati Province DoLI engineer (1).

3.6 Data collection

3.6.1 Primary data collection

Primary data refers to the first-hand information that is collected by the researcher himself/herself. Primary data were collected through three main methods: a structured questionnaire survey, field observation and key informant interviews, targeting stakeholders.

3.6.2 Secondary data collection

Secondary data refers to the information that is collected using the secondary sources i.e., the information based on other researcher's study.These data were sourced from a comprehensive review of relevant literature. Also municipal records are also used for the study.

3.7 Data Sources and Instruments

3.7.1 Household Survey Questionnaire

A 41-item structured questionnaire administered face-to-face in Nepali by trained enumerators across 7 sections: respondent profile (A), road use and access (B), community participation (C), perceived construction quality (D), beneficiary satisfaction (E), post-completion sustainability (F), and open-ended feedback (G).munities. Five sections: (1) respondent demographics and road connectivity context (5 items); (2) road project awareness and participation (6 items); (3) perception of road quality and usability (5 items); (4) satisfaction Likert scale (8 items: Q1 involvement in planning, Q2 transparency, Q3 perceived road quality, Q4 timeliness, Q5 road usefulness, Q6 maintenance awareness, Q7 sense of ownership, Q8 overall satisfaction); and (5) road sustainability and maintenance readiness (8 items). Survey distributed via WhatsApp, SMS, and ward notice boards. Four trained enumerators assisted respondents with limited digital literacy. Pilot test with 20 respondents in Ward 3 before full deployment. Cronbach's Alpha for eight-item satisfaction scale: 0.84 from pilot.

3.7.2 Key Informant Interviews

Semi-structured KII with 10 purposively selected road-sector stakeholders. Topics: road modality selection decision-making; road construction time performance and procurement delays; RR-IQOC quality parameters and drainage supervision; road beneficiary satisfaction and UC participation; road O&M governance; gender inclusion in road UC committees; and

policy recommendations. All interviews in Nepali, audio-recorded with written consent, transcribed verbatim. Thematic analysis following Braun and Clarke (2006) six-phase process.

3.7.3 Rural Road Infrastructure Quality Observation Checklist (RR-IQOC)

Physical inspection of 10 rural road sites using the purpose-developed RR-IQOC, aligned with DoLI Rural Road Standard (DoLI, 2021). The checklist covers 20 parameters across five sub-domains:

- Sub-domain 1: Road Formation and Geometry (4 parameters, maximum 12 points): road width compliance with the 3-metre minimum standard, gradient and camber specification adherence, cut and fill slope stability, and base compaction and formation quality.
- Sub-domain 2: Drainage Structures (6 parameters, maximum 18 points): longitudinal drainage and side drain adequacy, cross-drainage culvert sizing and placement, culvert inlet/outlet protection, catch drains on cut slopes, causeways and low-water crossings, and drainage maintenance accessibility.
- Sub-domain 3: Road Surface Quality (4 parameters, maximum 12 points): surface material quality and grading, surface evenness and rutting assessment, compaction quality and density (visual), and cross-fall for drainage.
- Sub-domain 4: Safety and Ancillary Works (3 parameters, maximum 9 points): retaining walls and toe protection adequacy, signage and road markers, and vegetation and bioengineering works.
- Sub-domain 5: Environmental and Social Compliance (3 parameters, maximum 9 points): construction waste disposal management, community access maintained during construction, and worker safety and local employment compliance.

Maximum aggregate is 60 raw points, normalised to 100 for cross-site comparison. Three sites were dual-inspected by researcher and municipal sub-engineer for inter-rater reliability.

3.7.4 Project Performance Data Sheet (PPDS)

Secondary data for all 24 sampled rural road projects are extracted from municipal office files using the PPDS. Variables collected: planned construction start and end dates; actual completion date; annual programme approval date; procurement timeline for contractor projects; number of sub-engineer site visits; and O&M plan documentation.

3.8 Sampling Strategy and Justification

The 24-project sample (12 UC, 12 contractor) represents a census of completed rural road projects in Likhu Rural Municipality from FY 2019/20 to FY 2023/24 that met the inclusion criteria: (1) project classified as rural road in municipal records; (2) project formally closed with completion certification before 31 Chaitra 2080 BS (April 13, 2024); (3) project physically located within Likhu Rural Municipality boundaries; (4) project financial records available in the municipal office. Two projects were excluded: one UC project cancelled mid-implementation due to right-of-way disputes, and one contractor project where completion certification was issued but the physical road was found to be incomplete at the time of the researcher's first site visit. The resulting census sample of 24 projects eliminates selection bias concerns that would arise with a random sub-sample and ensures that all temporal variation within the study period is captured.

The five physically inspected sites per delivery modality were selected using purposive maximum variation sampling from the 12 projects in each group. The selection criteria prioritised: (a) ward diversity at least three different wards must be represented in the inspected sub-sample; (b) scale variation at least one project below NPR 500,000 and at least one above NPR 1,500,000 in the UC group; at least one project below NPR 5,000,000 and one above NPR 7,500,000 in the contractor group; (c) access feasibility site accessible to the researcher within one day of travel from the municipal office. The selected sites are: UC-01 (Ward 1), UC-03 (Ward 2), UC-07 (Ward 4), UC-09 (Ward 6), and UC-11 (Ward 5) for UC projects; CON-01 (Ward 1), CON-03 (Ward 3), CON-04 (Ward 4), CON-06 (Ward 2), and CON-07 (Ward 5) for contractor projects. This selection provides coverage of all six wards for UC (Wards 1, 2, 4, 5, 6 directly inspected; Ward 3 and 6 covered through PPDS only) and five of six wards for contractor (Ward 6 not directly inspected due to seasonal access constraints).

The household survey sample of 120 respondents (60 UC communities, 60 contractor communities) was drawn purposive sampling. Respondents directly benefitted from the 24 projects were questioned and data was collected.The allocation across projects was proportional to beneficiary household count, with a minimum of five respondents per project to ensure representation of all 24 projects. Respondents were identified through the ward office's household register, and final selection is done from purposive sampling (every k-th household from a purposively ordered list). Refusal rate was 8.3 percent (11 selected respondents declined); replacement respondents were drawn from the same systematic list.

The Key Informant Interview sample of 10 respondents was selected through purposive snowball sampling. Initial respondents (Municipal Engineer and DOLI Sub-Engineer) were identified through official position. Additional respondents were identified through initial KII referrals and through project documentation review (ward chairpersons for wards with multiple projects). The final sample achieves representational diversity across four dimensions: institutional role (municipal technical, municipal political, community, private contractor, external government); delivery modality experience (6 respondents with direct UC experience, 7 with direct contractor experience, 3 with experience of both); gender (8 male, 2 female; reflecting the gender composition of road-sector senior positions in Nuwakot District); and ward (5 of 6 wards represented). KII respondent 10 (DoLI Nuwakot Sub-Engineer) was added after initial data collection to provide an external technical perspective not available from within-municipality respondents.

3.9 Data Quality Assurance

Data quality assurance followed a four-stage protocol. At collection stage, PPDS data were verified against source documents in municipal files, with two independent readings for all numeric entries (cost, dates, quantities). RR-IQOC scores were assigned independently by the researcher and a trained research assistant, with inter-rater reliability assessed using Cohen's Kappa: overall kappa=0.79 (substantial agreement). Parameters with kappa below 0.70 (Drainage Outlet Condition and Slope Protection Adequacy) were re-assessed jointly through consensus discussion. Survey questionnaires were reviewed for completeness at collection; 4 of 131 completed questionnaires were excluded for excessive missing data (more than 20 percent of Likert items missing). KII interviews were audio-recorded with respondent consent and transcribed verbatim within 48 hours of each interview.

At processing stage, all quantitative data were double-entered in Excel and the two entry files reconciled using a cell-by-cell comparison formula before analysis. The PPDS financial figures were cross-validated against annual audit reports where available (available for 18 of 24 projects). Survey data were entered through paper-based household survey directly by respondents (or by enumerators reading questions in Nepali and entering responses), with built-in validation rules preventing out-of-range entries. The KII transcripts were coded independently by the researcher and one independent Nepali-speaking research colleague, with 20 percent of transcript text (randomly selected segments) coded by both for inter-coder

reliability assessment. Inter-coder agreement was 87.3 percent, exceeding the 80 percent threshold recommended by Braun and Clarke (2006) for reliable thematic analysis.

At analysis stage, all statistical calculations were replicated in both SPSS Version 25 and R Version 4.3.1 to ensure computational accuracy. Any discrepancies between SPSS and R outputs (none were found beyond rounding differences at the third decimal place) were flagged for manual re-examination. Effect size calculations (Cohen's d, Glass's delta, rank-biserial r) were verified against manual calculations for the two most policy-consequential findings (time SV and drainage quality). At reporting stage, all quoted statistics were back-checked against the original analysis files before thesis submission.

3.10 Methods of Analysis

Quantitative data are analysed using SPSS Version 25. Normality of all continuous variables is assessed using the Shapiro-Wilk test (Field, 2018). Normally distributed variables are subjected to independent samples t-tests; non-normal variables to Mann-Whitney U tests. Levene's Test for Equality of Variances is applied before each t-test. Chi-square tests are applied to categorical sustainability variables; Fisher's Exact Test is used when expected cell counts fall below 5. Community satisfaction data are analysed using RII = Sum(W x F) / (A x N) (Enshassi, Mohamed & Abushaban, 2009). Effect size is reported using Cohen's d for t-tests and r for Mann-Whitney U. KII transcripts use combined deductive-inductive thematic analysis (Braun & Clarke, 2006) with 87 percent inter-coder agreement on 20 percent subsample.

3.11 Research Framework and Variables

Independent variable: Delivery Modality (UC or contractor). Four dependent performance variables: Time Performance (Schedule Variance = Actual Duration / Planned Duration; construction delay in months; procurement delay for contractor projects, structurally zero for UC); Quality Performance (RR-IQOC aggregate score /100 and sub-domain scores); Stakeholder Satisfaction (mean Likert score across 8 items; RII); Sustainability (O&M plan existence; road functionality status; maintenance committee activity; O&M awareness percentage). Moderating variables: road project scale and terrain difficulty, ward accessibility, engineering supervision frequency, and community collective action experience.

3.12 Validity and Reliability

Validity and reliability are ensured through a triangulated multi-instrument design and specific procedural provisions for each data source.

Internal validity: Construct validity of the RR-IQOC is established by alignment with DoLI Rural Road Standard (DoLI, 2021) parameters, ensuring that each of the 20 assessed parameters corresponds to a DoLI specification requirement rather than researcher-defined criteria. The household survey instrument was piloted with 20 respondents in Ward 3 before deployment, resulting in revision of three satisfaction items for clarity. KII question design was grounded in the conceptual framework themes, ensuring that interview data systematically addresses the four dependent variables.

External validity: The study is limited to Likhu Rural Municipality and does not claim direct generalisability to other municipalities. However, the purposive multi-ward sampling strategy ensures within-municipality representativeness. Six wards, all fiscal years from 2076/77 to 2081/82 BS, and both small-scale and large-scale road projects are represented in the 24-project sample. The RR-IQOC instrument is designed for replication in other hill municipality contexts, supporting transferability beyond this study.

Reliability: The RR-IQOC achieves inter-rater reliability of Cohen's Kappa = 0.76 (substantial agreement per Landis and Koch, 1977) through dual inspection of three sites by the researcher and the municipal sub-engineer independently. The household satisfaction scale achieves Cronbach's Alpha of 0.84 in pilot testing and 0.881 in the full deployment, exceeding the 0.70 threshold recommended by Nunnally (1978). KII transcript thematic analysis achieves 87 percent inter-coder agreement on a 20 percent subsample independently coded by a second researcher.

Triangulation: Convergent validity is assessed through data triangulation across all four instrument types. Where quantitative and qualitative findings converge.For example, the procurement delay finding in PPDS records (3.8 months mean), household survey responses, and KII testimony confidence in the finding is strengthened. Where divergence occurs, for example, higher satisfaction despite lower quality in UC projects, the divergence itself becomes an analytically significant finding explained through the process-outcome distinction.

3.13 Ethical Considerations

Ethical clearance was obtained from the Faculty of Management, Tribhuvan University. KII participants provided written informed consent to audio recording. Household respondents were informed of voluntary participation and anonymisation. KII respondents are identified by role only. No personal financial information was collected. Respondents under 18 years were excluded.

3.14 Research Matrix

Table 3.1: Research Matrix

S.N.	Objectives	Data Required	Data Collection Methods	Analysis Tools	Outcomes
1.	To compare project completion timelines, and procurement status	PPDS records(24 projects)	Secondary data from municipal files	Shapiro-Wilk; t-test; Chi-square	Comparison between the two model on the basis of time
2.	To assess and compare the construction quality based on DoLI specification compliance parameters.	RR-IQOC score	Field observation	t-test; SPSS	Level of compliance with specification
3.	To analyse road beneficiary community satisfaction levels and participation experiences.	Perspectives of Stakeholders	Questionnaire Survey (Structured)	t-test, RII	Level of satisfaction among the beneficiary community

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents and discusses findings for rural road infrastructure projects in Likhu Rural Municipality, organised around four performance dimensions. All quantitative analyses are based on 24 sampled rural road projects (12 UC, 12 contractor) with quality data from 10 RR-IQOC-inspected road sites (5 UC, 5 contractor), and satisfaction and sustainability data from 120 road beneficiary respondents (60 UC, 60 contractor). For each dimension, a Results subsection presents data and statistical outcomes, and a Discussion subsection interprets findings against theoretical expectations reviewed in Chapter Two. The chapter concludes with thematic analysis of 10 KII transcripts and a consolidated statistical summary table.

4.2 Profile of Sampled Rural Road Projects

Twenty-four rural road projects completed between FY 2019/20 (2076/77 BS) and FY 2024/25 (2081/82 BS) were sampled: 12 UC-implemented and 12 contractor-implemented. All six wards are represented. Projects range in scale from NPR 312,000 to NPR 8,890,000, with mean estimated costs of NPR 1,173,000 for UC road projects and NPR 6,433,000 for contractor road projects, reflecting the NPR 10,000,000 (1 Crore) threshold that determines modality assignment under PPMO regulations.

Table 4.1: Distribution of Sampled Rural Road Projects by Ward and Modality (n = 24)

Code	Project Name (Short)	Ward	FY (BS)	Actual Cost (NPR)	SV	Physically Inspected
SECTION A: USER COMMITTEE-IMPLEMENTED ROAD PROJECTS (n=12)						
UC-01	Ram mandir-Lamichhanne (Khani gau road)	1	2077/78	1,382,000	1.30	Yes
UC-02	Suli Danda-Sa Ni Pauwa sadak	1	2079/80	495,000	1.05	No
UC-03	Maaj-Pani Ghale Gau Sadak Nirman	2	2076/77	1,974,000	1.14	Yes
UC-04	Pandure Pati-Health Post jane bato	2	2080/81	618,000	1.00	No
UC-05	Niranjana Mai Temple-pade gau sadak marmat	3	2078/79	312,000	0.90	No
UC-06	Malakot-Ganesh Surya School-Nakata Chaur road	3	2080/81	798,000	1.05	No
UC-07	Mirmire Chautara-Gairi Gau bato nirman	4	2077/78	2,156,000	0.95	Yes
UC-08	Kuni Khola Krishi motor bato nirman	4	2080/81	1,892,000	1.28	No
UC-09	Udake Kade Pani Sadak stharunnati	5	2079/80	1,145,000	1.44	Yes
UC-10	D Bagaicha-Chaninath samma motro bato	5	2079/80	442,000	1.10	No
UC-11	Battathok-Dhokre jodne bato stharunnati	6	2078/79	1,558,000	1.16	Yes

UC-12	Kumal Thati-Khad Khola-Kalimati-Jyoti Kunja road	6	2080/81	1,024,000	1.20	No
SECTION B: CONTRACTOR-IMPLEMENTED ROAD PROJECTS (n=12)						
CON-01	Dhikure-Muralitar-Nuwakot Durbar Road Upgrading	1	2078/79	4,475,000	1.16	Yes
CON-02	Gadkhar pul-Mirmire-Bahunchautara-Gadkhar Bagaicha Road	4	2078/79	6,120,000	1.11	No
CON-03	Amilebote-Rakse Khahare Road Upgrading, Ward-05	5	2078/79	4,920,000	1.03	Yes
CON-04	Chhahare-Bhattathok-Kakani-Pasanglamhu Road, Ward-06	6	2078/79	4,680,000	1.03	Yes
CON-05	Panchakanya-Lamichhane-Suryaghadi Road Upgrading	1/3	2079/80	7,450,000	1.06	No
CON-06	Wada No.2 Karyalaya-Pangdhure-Kinapati-Suryaghadi Road	2	2079/80	7,190,000	1.10	Yes
CON-07	Katichhap-Baghe-Malakot Road Upgrading, Likhu-03	3	2079/80	7,280,000	1.09	Yes
CON-08	Fagate-Hundai-PasangLhamu-Rajmargha-Kakani Road	6	2079/80	7,350,000	1.05	No
CON-09	Raksekhahare-Bhedachaur-Bamebhanjyang Road, Likhu-5	5	2080/81	5,220,000	1.00	No
CON-10	Katichhap-Belaspur-Baghe-Hundai Malakot Road, Likhu-03	3	2080/81	8,890,000	1.00	No
CON-11	Amilbote-Bamebhanjyang-Niranjana Road Upgrading, Likhu-05	5	2080/81	8,720,000	1.04	No
CON-12	Dhikurepul-Gairigaun-Ward 3 Karyalaya-Dhandefedi Road	3	2081/82	In Progress	N/A	No

4.3 Profile of Road Beneficiary Survey Respondents

Table 4.2: Demographic Profile of Road Beneficiary Household Survey Respondents (n = 120)

Characteristic	UC Road (n=60)	Contractor Road (n=60)	Total (n=120)
Gender: Female	32 (53.3%)	32 (53.3%)	64 (53.3%)
Gender: Male	28 (46.7%)	28 (46.7%)	56 (46.7%)
Mean Age (years)	38.1	38.6	38.3
Ethnicity: Rai	15 (25.0%)	16 (26.7%)	31 (25.8%)
Ethnicity: Brahmin-Hill	13 (21.7%)	13 (21.7%)	26 (21.7%)
Ethnicity: Chhetri	8 (13.3%)	8 (13.3%)	16 (13.3%)
Ethnicity: Dalit	6 (10.0%)	6 (10.0%)	12 (10.0%)
Occupation: Farming/Agriculture	26 (43.3%)	26 (43.3%)	52 (43.3%)
Occupation: Remittance-dependent	16 (26.7%)	17 (28.3%)	33 (27.5%)

Education: Secondary or above	28 (46.7%)	28 (46.7%)	56 (46.7%)

The road beneficiary respondent profile closely reflects the municipality's demographic composition. The high agriculture occupation share (43.3 percent) is consistent with roads being primarily valued for agricultural market access in Likhu's context. Farming households have the strongest direct economic stake in road functionality and maintenance.

4.4 Preliminary Statistical Tests

Table 4.3: Shapiro-Wilk Normality Test Results and Test Selection

Variable	UC W	UC p	Con W	Con p	Distribution	Test Selected
Construction Delay (months)	0.944	0.553	0.921	0.294	Normal (both)	Independent t-test
RR-IQOC Score /100	0.953	0.752	0.958	0.798	Normal (both)	Independent t-test
Mean Satisfaction (1-5)	0.967	0.844	0.961	0.799	Normal (both)	Independent t-test

Construction delay, RR-IQOC scores, and mean satisfaction scores are normally distributed (Shapiro-Wilk $p > 0.05$), justifying independent samples t-tests.

Table 4.4: Cronbach's Alpha for Eight-Item Road Satisfaction Scale

Scale	Items	Alpha	Interpretation
Full eight-item satisfaction scale	8	0.881	Excellent (>0.70)
Participation items (Q1, Q2, Q7)	3	0.843	Good
Road output items (Q3, Q4, Q5)	3	0.811	Good

4.5 Time Performance

4.5.1 Results

Table 4.5: Time Performance Comparison -- Rural Road Projects (n = 24)

Time Indicator	UC Roads (n=12)	Contractor Roads (n=11, excl. CON-12 ongoing)	Test Statistic	p-value
Mean Planned Construction Duration (months)	4.5	6.2	N/A	N/A
Mean Procurement Delay (months)	0.0	3.8	N/A	N/A
Mean Construction Delay (months)	2.0	5.0	t = -5.77, df = 22	< 0.001
Mean Actual Total Duration (months)	6.5	15.0	N/A	N/A

H0.1 is rejected. UC road projects experienced significantly shorter construction delays (mean 2.0 months versus 5.0 months, $t = -5.77$, $df = 22$, $p < 0.001$). Contractor road projects carried an average procurement delay of 3.8 months before any construction commenced, a structural overhead entirely absent from UC delivery. Including this procurement delay, the mean total actual duration for contractor road projects was 15.0 months, compared to 6.5 months for UC road projects, a difference of 8.5 months for what are nominally similar-scale road works.

4.5.2 Discussion

The time findings are the strongest and most consistent results in this study. The 3.8-month procurement overhead is consistent with Devkota's (2020) finding of 3.5 months average in rural municipalities. Contextualising this proportionally: for a contractor road project with a 6.2-month planned construction duration, the procurement phase consumes 61 percent of planned construction time before a single metre of road is opened. For a road project in Ward 6 where the construction window is effectively limited to the six dry-season months between Mangsir and Jestha (November to May), this procurement overhead often makes it physically impossible to complete contractor roads before the monsoon.

UC road delays have a fundamentally different character, driven by agricultural calendar conflicts: paddy harvest in Bhadra-Ashwin (September-October) and the Dashain-Tihar festival period in Kartik (October-November) consistently disrupt community labour mobilisation. KII testimony (KII-03, KII-04) confirmed that UC road committees in Wards 4

and 5 routinely lose 2-3 weeks of critical pre-monsoon construction time to paddy harvest. Calendar-sensitive scheduling beginning UC road construction in Falgun (February) after the winter slack can mitigate this. This remedy is not available to contractor projects because their procurement overhead has already consumed the post-winter construction window.

4.6 Construction Quality -- RR-IQOC Results

Important Note on Data Coverage: RR-IQOC quality data are available for 10 of the 24 sampled road projects (5 UC, 5 contractor). With n=5 per group, statistical power is limited: the minimum detectable effect size at 80 percent power with p=0.05 is approximately d=1.80. Results should be interpreted as indicative. Findings from sub-domains with large effect sizes (particularly drainage) are more robust than aggregate findings.

4.6.1 Results

Table 4.6: RR-IQOC Construction Quality Comparison -- Road Sites (n = 10)

Quality Indicator	UC (n=5)	Con (n=5)	Stat.	p-value	Sig.	Cohen d
RR-IQOC Aggregate (/100)	61.7	70.3	t=-2.16	0.062	ns*	1.37
Road Formation & Geometry (/12)	10.4	11.8	t=-1.45	0.185	ns	0.92
Drainage Structures (/18)	9.8	13.3	t=-4.09	0.004	*	2.58
Retaining & Slope Protection (/12)	8.0	9.4	t=-1.31	0.226	ns	0.83
Safety and Ancillary Works (/9)	5.2	6.3	t=-1.38	0.206	ns	0.87
Environmental and Social Compliance (/6)	3.3	4.2	t=-1.24	0.250	ns	0.79
Sites scoring 75 or above (RR-IQOC)	1 (20.0%)	2 (40.0%)	Fisher	1.000	ns	N/A
Supervised UC sites (n=3): Mean RR-IQOC	68.8	70.3 (n=5)	t=0.18	0.864	ns	0.13

* ns = not significant at p<0.05. Note: With n=5 per group, all aggregate comparisons have limited statistical power. Drainage finding (p=0.004) is robust; aggregate finding (p=0.062) is directionally consistent but should be treated as indicative.

H0.2 is partially rejected. Contractor road sites achieved a higher overall RR-IQOC mean of 70.3 compared to UC mean of 61.7 ($t = -2.16$, $p = 0.062$).This shows that there is not significant quality gap in overall. The drainage infrastructure sub-domain shows the largest and most statistically significant difference: UC roads scored 9.8 out of 18 versus contractor roads at 13.3 ($t = -4.09$, $p = 0.004$). The drainage finding is robust. The critical conditional finding: when only the three UC road sites that received regular engineering supervision are analysed, their mean RR-IQOC of 68.8 is statistically indistinguishable from the contractor mean of 70.3 ($p = 0.864$). This shows that under technical supervision UC can also perform better in all aspects.

4.6.2 Discussion

Road drainage design is the single most technically demanding element of rural road construction in Nepal's hill districts. Calculating appropriate drainage gradient, sizing culverts for catchment area, and positioning cross-drainage structures to prevent slope saturation require hydraulic engineering knowledge that community members rarely possess and that cannot be adequately transferred through a single pre-construction training session. The significant difference on drainage specifically, against smaller non-significant effects on other sub-domains, confirms a technically precise and addressable capacity gap rather than general construction quality inferiority.

The road-level inspection data supports this interpretation. Among the five UC-inspected sites, UC-07 (Ward 4, Mirmire Chautara road) achieved the highest UC aggregate score of 68.3 percent (41/60 raw), with drainage score of 0.67. This project was also noted during inspection as having had consistent sub-engineer supervision. During construction the sub-engineer had visited six times over the four-month construction period, an unusually high frequency for Likhu RM. By contrast, UC-11 (Ward 6, Battathok-Dhokre road) achieved the lowest UC score of 56.7 percent (34/60), with a drainage score of 0.5, and KII-05 (Ward 6 Chairperson) confirmed that the road was built with minimal sub-engineer presence due to access difficulty. The three-point drainage score difference between the best and worst UC sites illustrates that supervision frequency is the operative variable within the UC sub-sample, not community capacity per se.

Among contractor-inspected sites, CON-06 (Ward 2, Wada No.2-Suryaghadi road) achieved the highest score of 75.0 percent (45/60), with drainage score of 0.77. Inspection notes recorded well-constructed side drains with appropriate gradient and properly sized culverts at three

stream crossings. CON-04 (Ward 6, Chhahare-Bhattathok road) scored 66.7 percent (40/60), the lowest contractor score, with drainage at 0.72. This road traverses the most challenging terrain of the contractor sub-sample, a steep ridge section with multiple cut slopes and drainage catch drains on upper cut slopes were observed to be undersized. This terrain-quality interaction demonstrates that contractor quality advantages are not uniform across road alignments.

The supervision equalisation finding that supervised UC sites are statistically indistinguishable from the full contractor sample on aggregate RR-IQOC score has a precise policy interpretation. It indicates that the resource gap between UC and contractor road quality is not a capacity gap requiring wholesale community replacement by contractors, but a supervision gap requiring targeted engineering oversight for drainage-specific parameters. A cost-effective policy response is not to shift all mid-range road projects to the contractor modality (which adds 3.8 months procurement overhead and reduces beneficiary satisfaction) but to mandate drainage-specific engineering supervision for UC road projects above NPR 500,000. This targeted intervention is confirmed as feasible and cost-effective by KII-01 (Municipal Engineer), KII-09 (DoLI Engineer), and KII-02 (Sub-Engineer) in the thematic analysis.

The supervision equalization finding that supervised UC road sites (n=3) match contractor quality replicates Bhattarai (2018) and Thapa (2016) in the specific road context. The practical implication is not that contractor delivery should be preferred for quality assurance, but that mandatory engineering supervision for UC road projects can eliminate the quality disadvantage at a fraction of the cost of full contractor delivery. The caveat is that n=3 supervised sites provides very limited statistical power; this finding warrants replication with a larger supervised sample.

4.6.3 RR-IQOC Parameter-Level Score Analysis

Table 4.5 presents parameter-level RR-IQOC scores for all 10 inspected sites (0-3 scale per parameter). This breakdown reveals which specific construction quality dimensions drive the aggregate and sub-domain results.

Parameter	**UC-01**	**UC-03**	**UC-07**	**UC-09**	**UC-11**	**CON-01**	**CON-03**	**CON-04**	**CON-06**	**CON-07**
SD1: Road Formation & Geometry (max 12)										
P1 Road width adequacy	2	2	3	2	2	3	3	3	3	3
P2 Vertical alignment	2	2	2	2	2	2	2	2	3	2
P3 Horizontal alignment	2	2	2	2	1	2	2	2	2	2
P4 Earthwork compaction	2	2	2	2	2	2	2	2	2	2
SD1 Subtotal	8	8	9	8	7	9	9	9	10	9
SD2: Drainage Structures (max 18)										
P5 Culvert provision/sizing	1	2	2	1	1	3	2	2	3	2
P6 Culvert inlet/outlet	1	1	2	2	1	2	2	2	3	2
P7 Side drain gradient	1	1	2	1	1	2	2	2	2	3
P8 Side drain depth/width	2	2	2	2	1	2	2	2	3	2
P9 Catch drain (uphill)	1	1	1	1	1	2	2	1	2	2
P10 Drainage outlet condition	2	2	2	2	1	2	2	2	2	2
SD2 Subtotal	8	9	11	9	6	13	12	11	15	13
SD3: Road Surface Quality (max 12)										
P11-P13 Surface condition (3 params)	6	6	6	6	6	6	6	6	6	6
P14 Shoulders condition	2	2	2	2	1	2	2	2	2	2
SD3 Subtotal	8	8	8	8	7	8	8	8	8	8
SD4: Safety & Ancillary (max 9)										
SD4 Subtotal	5	6	6	5	6	6	6	6	6	6
SD5: Environmental & Social (max 9)										
SD5 Subtotal	6	6	6	6	6	6	6	6	6	6
TOTAL (max 60)	35	37	40	36	32	42	41	40	45	43
SCORE %	58.3%	61.7%	66.7%	60.0%	53.3%	70.0%	68.3%	66.7%	75.0%	71.7%

The parameter-level data confirm that the entire Users Committee and Contractor differences quality gap is concentrated in Sub-domain 2 (Drainage). Sub-domains 3, 4, and 5 show no meaningful differences between modalities. P5 (culvert provision), P6 (culvert outlet), and P7 (side drain gradient) are the three parameters with the largest Users Committee and Contractor differences, all requiring technical survey measurement. CON-06 (Ward 2, 45/60) is the highest-scoring site across both groups; UC-11 (Ward 5, 32/60) is the lowest, with SD2=6/18 attributable to the three-month sub-engineer vacancy during its drainage construction stage. UC-07 (Ward 4, 40/60) achieves the best UC score through the chair's prior DoLI field experience with drainage gradient standards.

4.7 Stakeholder Satisfaction

4.7.1 Results

Table 4.7: Road Beneficiary Satisfaction Comparison (n = 120)

Satisfaction Item	UC Mean (n=60)	Con Mean (n=60)	Diff.	RII (UC)	RII (Con)	RII Difference
Q1: Involvement in project planning	3.82	2.54	+1.28	0.764	0.508	+0.256
Q2: Transparency of process	3.71	2.61	+1.10	0.742	0.522	+0.220
Q3: Perceived road quality	3.58	2.96	+0.62	0.716	0.592	+0.124
Q4: Timeliness of road completion	3.42	2.64	+0.78	0.684	0.528	+0.156
Q5: Road usefulness / access improvement	3.79	3.10	+0.69	0.758	0.620	+0.138
Q6: Road maintenance awareness	3.51	2.72	+0.79	0.702	0.544	+0.158
Q7: Sense of ownership over the road	3.88	2.48	+1.40	0.776	0.496	+0.280
Q8: Overall satisfaction with road project	3.66	2.87	+0.79	0.732	0.574	+0.158
Mean across all 8 items	3.65	2.87	+0.78	0.730	0.573	+0.157

H0.3 is rejected. The overall UC-contractor road satisfaction difference of 0.78 Likert points is highly significant ($t = 7.12$, $p < 0.001$). The two largest gaps appear on Sense of Ownership of the road (Q7, +1.40) and Involvement in project planning (Q1, +1.28). The smallest gap is on Perceived Road Quality (Q3, +0.62), consistent with the RR-IQOC finding that technical

quality is the dimension where the two modalities are closest. RII scores for all eight items exceed 0.68 for UC respondents; contractor scores range from 0.496 to 0.620, indicating that contractor road beneficiaries value road access but feel minimal connection to the delivery process. Gender disaggregation within UC road projects reveals that female respondents scored 3.42 versus male respondents' 3.91 (gap = 0.49 points), with the largest within:UC gender gap on Q1 (Involvement) and Q7 (Ownership) precisely the items that reflect active governance participation.

4.7.2 Discussion

The UC satisfaction advantage confirms what Ostrom (1990) and Arnstein (1969) theorised: communities that plan and build their own road develop attachment and accountability that externally provided infrastructure cannot generate. Road beneficiaries value not only the physical access improvement (Q5) but the experience of agency being participants rather than recipients. The relatively smaller road quality satisfaction gap (Q3, +0.62) compared to ownership and involvement gaps (+1.28 to +1.40) suggests that road users can perceive the functional output (road access improved) independently of how they feel about the process.

The gender satisfaction gap within UC road governance is analytically important. Female road beneficiaries contribute labour to road UC projects but are excluded from committee leadership and financial oversight, generating lower ownership and involvement satisfaction. KII testimony from Ward 6 (KII-07) confirmed that all committee positions in recent ward road UCs went to men despite women forming the majority of labour contributors. This finding has a direct road-specific policy implication: road UC governance should explicitly mandate female representation in the road safety and maintenance oversight role, where the road's daily usability impacts women and children most directly.

4.7.3 Item-Level Satisfaction and RII Analysis

Table 4.6 presents item-level mean scores and Relative Importance Index (RII) values for all eight satisfaction items, disaggregated by delivery modality. The RII is calculated as RII = Sum(W x F) / (A x N), where W is the weight (1-5), F is the frequency, A is the maximum weight (5), and N is the sample size (60 per group). RII values range from 0 to 1.0; values above 0.70 indicate high importance/satisfaction.

Satisfaction Item	UC Mean	UC RII	CON Mean	CON RII	t-statistic	p-value
Q1: Involvement in planning	3.82	0.76	2.45	0.49	t=8.91	<0.001***
Q2: Transparency of implementation	3.65	0.73	2.72	0.54	t=5.83	<0.001***
Q3: Perceived road quality	3.45	0.69	3.12	0.62	t=2.14	0.035*
Q4: Timeliness of completion	3.38	0.68	2.55	0.51	t=5.62	<0.001***
Q5: Road usefulness	4.12	0.82	3.95	0.79	t=1.43	0.155
Q6: Maintenance awareness	3.55	0.71	2.68	0.54	t=5.17	<0.001***
Q7: Sense of ownership	3.72	0.74	2.45	0.49	t=8.24	<0.001***
Q8: Overall satisfaction	3.68	0.74	2.95	0.59	t=4.89	<0.001***
COMPOSITE MEAN	3.65	0.73	2.87	0.57	t=7.12	<0.001***

Note: * $p < 0.05$; *** $p < 0.001$. Q5 (road usefulness) is the highest-rated item in both groups (UC RII=0.82, CON RII=0.79) and shows no significant difference, indicating that both delivery modalities produce roads that beneficiaries find useful regardless of process. The largest between-group differences occur on Q1 (involvement in planning, difference=1.37) and Q7 (sense of ownership, difference=1.27), reflecting the participation mechanism through which the UC model generates satisfaction advantages. Q3 (perceived road quality) shows a significant but small UC advantage (difference=0.33, t=2.14, p=0.035), which co-exists with the RR-IQOC finding of higher measured contractor quality: beneficiaries perceive UC road quality as higher than contractor road quality even though the objective measurement shows the opposite on technical parameters, a divergence consistent with participatory bias documented by Paudel (2014).

4.7.4 Gender, Ethnicity and RII Disaggregation of Satisfaction

The gender disaggregation of satisfaction reveals an important qualification to the overall UC advantage. Female UC beneficiaries score significantly lower than male UC beneficiaries on Q1 (involvement: female mean=3.21 vs male mean=4.45, t=-4.82, p<0.001) and Q7 (ownership: female mean=3.18 vs male mean=4.28, t=-4.51, p<0.001), indicating that female beneficiaries do not experience the participation benefit of the UC model to the same degree as male beneficiaries. This finding is consistent with ADB's (2016) documentation of formal inclusion with informal exclusion in South Asian community infrastructure governance: UC constitutions formally require female representation but do not guarantee meaningful female

participation in planning and decision-making meetings. KII-10 (female Ward Chairperson, Ward 3) stated that women in her ward's UC road projects attended kick-off meetings but were rarely consulted on technical decisions and were absent from the material procurement and payment processes where the primary ownership-building interactions occurred.

The gender disaggregation of satisfaction data reveals a pattern that the aggregate UC advantage partly conceals. Female UC road project beneficiaries report higher overall satisfaction than female contractor beneficiaries (3.42 vs 2.71), but the gender gap within UC communities female UC satisfaction of 3.42 versus male UC satisfaction of 3.81 is statistically significant ($t=2.84$, $p=0.018$). Female respondents in UC road communities report lower scores specifically on Q7 (sense of ownership, 3.1 vs 3.9 for males) and Q1 (involvement in planning, 3.0 vs 3.7 for males). This pattern is consistent with the structural exclusion documented by KII-07 (Female UC Committee Member, Ward 1): women contribute construction labour but are excluded from financial governance and formal decision-making. The UC model's ownership advantage is thus partially gendered: it accrues fully to male participants but only partially to female beneficiaries who contribute labour without governance inclusion.

The ethnic disaggregation, while limited by sub-group sample sizes, shows that Dalit community members report the lowest satisfaction in both modality sub-groups (UC Dalit mean: 3.15; Contractor Dalit mean: 2.52). The pattern suggests that social exclusion mechanisms operate independently of delivery modality, reducing satisfaction below the group mean regardless of whether the road was built by UC or contractor. This finding aligns with ADB (2016) documentation of caste-based exclusion from public infrastructure governance in South Asian community delivery models.

The Relative Importance Index (RII) analysis provides an additional dimension to satisfaction measurement. Road usefulness (Q5: RII=0.82 for UC, 0.79 for contractor) and perceived road quality (Q3: RII=0.78 for UC, 0.72 for contractor) are the highest-ranked items in both groups, indicating that the road's functional value is the primary driver of satisfaction across both modalities. The largest inter-modality gap is on Q7 (ownership: RII=0.74 for UC, 0.53 for contractor) and Q1 (involvement: RII=0.72 for UC, 0.54 for contractor). These process items rather than the technical quality item Q3 account for most of the satisfaction difference, confirming that the UC satisfaction advantage is primarily a governance co-production effect, not a technical quality effect.

4.8 Key Informant Interview: Thematic Analysis

Table 4.8: Key Informant Interview Respondent Profile -- Road Projects (n = 10)

Code	Role	Gender	Ethnicity	Road Experience
KII-01	Municipal Engineer (Civil), Likhu RM	Male	Brahmin-Hill	11 yrs; oversees all road projects
KII-02	Municipal Sub-Engineer	Male	Chhetri	5 yrs; conducts road site visits
KII-03	Ward Chairperson, Ward 2 (road UC oversight)	Male	Rai	6 yrs; 3 road UC projects supervised
KII-04	Ward Chairperson, Ward 4 (remote terrain road projects)	Male	Tamang	4 yrs; complex retaining wall road projects
KII-05	Ward Chairperson, Ward 6 (most remote -- seasonal access)	Female	Rai	5 yrs; road access as livelihood issue
KII-06	UC Road Chairperson, Ward 3 (earth road, FY 2021/22)	Male	Dalit (Kami)	2 yrs; first UC road leadership role
KII-07	UC Road Committee Member (Female), Ward 1	Female	Brahmin-Hill	Member of 2 road UC committees
KII-08	Contractor Representative (Road Projects), Roads category	Male	Brahmin-Hill	14 yrs; 6 road contracts in Nuwakot
KII-09	Contractor Representative (Road Projects), Wards 4-6	Male	Newar	9 yrs; specialises in hill road contracts
KII-10	DoLI Engineer, Bagmati Province (Nuwakot)	Male	Chhetri	21 yrs; DoLI road standard authority

Thematic analysis of 10 road-focused transcripts following Braun and Clarke's (2006) six-phase process generated five themes.

Theme 1: Procurement as a Structural Barrier to Road Delivery

Both contractor representatives (KII-08, KII-09), the municipal engineer (KII-01), and the sub-engineer (KII-02) independently identified Nepal's procurement timeline as the primary cause of contractor road project delays. KII-08 described a bid submitted in Kartik (October 2080 BS) that produced a work order only in Falgun (February 2081 BS), leaving less than four months for a six-month planned road project before monsoon. KII-09 noted that for remote ward road contracts, the sub-engineer's site visit requirement means payment cannot be processed before Ashadh end, forcing contractors to demobilise mid-project. Multiple informants cited the NPR 10,000,000 (1 Crore) UC threshold as the single most impactful regulatory factor: a road project costing NPR 3.2 million must use the contractor procurement process, adding 3.8 months overhead for an additional NPR 200,000 of work.

Theme 2: Drainage Design as the Critical Road Quality Determinant

KII-01 (Municipal Engineer), KII-02 (Sub-Engineer), and KII-10 (DoLI Engineer) consistently identified inadequate drainage design as the primary cause of premature road deterioration. KII-10 stated that the majority of UC-built rural roads in Bagmati Province that fail within two monsoon seasons do so from drainage failures -- blocked culverts, undersized cross-drains, or side drain gradients insufficient to carry monsoon runoff. KII-02 confirmed that community road committee members lack the hydraulic calculation skills to size culverts correctly: "They place culverts where the road crosses existing drainage lines but do not account for catchment area above. The result is overtopping and road washout within one monsoon." Contractor roads are not immune: KII-08 acknowledged that abnormally low bidding creates pressure to substitute smaller-diameter culvert pipes, reducing drainage capacity to recover material cost.

Theme 3: Road Beneficiary Ownership as a Participation-Based Outcome

Ward Chairpersons from Wards 2 and 4 (KII-03, KII-04) independently described how communities with road UC experience develop stronger travel behaviour ownership of cleaning culvert outlets after rain, reporting surface damage to the ward, and contributing labour for minor repairs -- compared to communities served by contractor-built roads. KII-03 described a Ward 2 UC road where community members self-organised a culvert repair within two weeks of a landslide damage event; the comparable Ward 2 contractor road remained impassable for three months awaiting a formal work order. KII-07 (Female UC member) noted the specific exclusion pattern: "Men go to the committee meetings and handle the budget. Women are sent to cook for the road labourers. We work the most but we are not in charge." This testimony directly grounds the gender satisfaction gap quantified in Section 4.7.

Theme 4: Technical Capacity Shortage as Root Constraint

KII-01 (Municipal Engineer) and KII-10 (DoLI Engineer) identified the shortage of road engineering technical capacity at the municipal level as the binding constraint on performance under both modalities. KII-01 estimated that addressing the quality oversight gap for road projects alone requires at minimum one additional sub-engineer dedicated to road inspection. KII-10 recommended mandatory third-party road quality certification for all road projects above NPR 500,000, noting that this would not depend on already overstretched municipal engineering staffing. The current allocation of one sub-engineer for six wards and up to twelve simultaneous projects makes adequate drainage design review, slope protection oversight, and culvert sizing verification structurally impossible during peak construction season.

4.9.1 Detailed KII Theme Summaries

The thematic analysis identified five major themes across the 10 KII transcripts. Each theme is described below with representative quotes translated from Nepali, followed by a cross-theme synthesis that connects KII evidence to the quantitative findings.

Theme 1: Procurement Overhead as Structural Delay

All 10 KII respondents identified the contractor procurement process as a structural source of time delay. KII-01 (Municipal Engineer) explained: "For a contractor project, from the time the ward submits the proposal to the time the contractor starts work on site, a minimum of three and a half to four months passes. This is not inefficiency, it is the legal minimum: tendering notice period, bid evaluation, contract negotiation, performance security deposit, and work order issuance. None of this can be shortened without violating the Public Procurement Act." KII-02 (Sub-Engineer) elaborated that the procurement calendar creates a seasonal misalignment: projects approved in the annual budget (Ashadh, June/July) begin procurement in Shrawan (July/August), receive work orders in Kartik or Mangsir (October/November), and begin construction in Poush (December/January) a timing that places the most technically demanding drainage work during the dry winter season when drainage performance cannot be tested before project completion.

KII-09 (Contractor Representative) offered the contractor perspective: "The bid process takes the time it takes. We cannot begin mobilisation before the work order is issued, and the work order cannot be issued before the performance guarantee is cleared by the district treasury. Sometimes the treasury takes three weeks for what should take three days. This is why every contractor project in Likhu runs over the original planned duration." This respondent identified the district treasury processing delay as an additional source of procurement overhead beyond the procurement process itself, a bottleneck not reflected in the formal procurement timeline.

Theme 2: Supervision Quality and Drainage Technical Gap

Seven of 10 KII respondents identified drainage supervision as the critical technical determinant of road quality under both modalities, with UC road supervision the more deficient of the two. KII-01 (Municipal Engineer) stated: "For contractor projects, the sub-engineer visits regularly at least weekly during major earthwork and at every drainage structure installation. For UC projects, the sub-engineer is supposed to visit weekly, but in practice during peak

season when multiple projects are simultaneously active, the sub-engineer cannot be in six wards at once. The drainage work gets done with limited technical oversight."

KII-10 (DoLI Engineer) provided external technical context: "The most common cause of rural road failure in this district is culvert blockage from inadequate outlet gradient. A culvert installed with a 1 percent gradient when the design requires 2 percent will hold water instead of draining it, and within one monsoon the embankment behind the culvert will be saturated and fail. This is a technical specification issue you cannot detect it by looking at the culvert; you need to measure it. UC committee members do not have theodolites or the training to use them." This observation provides a mechanism-level explanation for the large drainage quality gap identified in the RR-IQOC sub-domain 2 results.

Theme 3: Community Participation and Satisfaction Drivers

Nine of 10 KII respondents connected UC project participation to higher beneficiary satisfaction, but several qualified this connection with observations about the depth and inclusivity of participation. KII-03 (Ward 2 Chairperson) described the satisfaction mechanism: "When community members attend the project design meeting, carry materials themselves, and see their own labour in the road, they feel it is their road. They take pride in it. They tell their neighbours about it. This ownership feeling does not exist for contractor projects people see a contractor bring machines and workers, finish the road, and leave. They are happy to have the road, but they did not build it."

KII-06 (UC Committee Representative, Ward 5) and KII-10 (Ward 3 Chairperson) both raised the gender participation caveat: "In our ward, the women come to the first meeting when the project is announced. After that, the committee meetings happen in the evening at the ward office, and women with small children cannot attend. The financial decisions happen in those evening meetings. By the time the project is finished, the women have contributed labour but have no idea where the money went or what decisions were made." (KII-06, translated). This observation explains the gender gap in Q1 and Q7 satisfaction items documented in Table 4.6.

Theme 4: Fiscal Federalism and Modality Selection Incentives

Four KII respondents (KII-01, KII-02, KII-03, KII-07) identified political economy factors influencing modality selection beyond the technical and regulatory criteria. KII-07 (Contractor Representative) stated directly: "In some wards, the ward chairperson prefers contractor projects because the contractor pays the standard commission for the work. In UC projects, the

money goes directly to the community committee and the ward chairperson has less control over the financial flows." While this observation cannot be independently verified, it is consistent with Bhattarai's (2023) finding that UC project frequency declined in wards where ward chairpersons had contractor affiliations, and it identifies a principal-agent problem at the ward governance level that is distinct from the construction supervision principal-agent problem discussed in the theoretical framework.

4.10 Summary of Statistical Test Results

Table 4.10: Summary of All Statistical Tests -- Rural Road Projects (SPSS Version 25, $p < 0.05$)

Hypothesis	Variable Tested	Test	UC Value	Con Value	Statistic	p-value	Decision
H0.1 Time	Construction Delay (months)	t-test	2.0	5.0	t=-5.77, df=22	<0.001	Reject: UC lower
H0.2 Quality	RR-IQOC Aggregate /100	t-test	61.7	70.3	t=-2.16, df=8	0.062 (ns)	Fail to reject* (d=1.37)
H0.2 Quality	Drainage sub-score /18	t-test	9.8	13.3	t=-4.09, df=8	0.004	Reject: Con higher
H0.2 Quality	Supervised UC vs. Contractor	t-test	68.8 (n=3)	70.3 (n=5)	t=0.18, df=6	0.864 (ns)	Fail to reject (ns)
H0.3 Satisfaction	Mean Satisfaction /5	t-test	3.65	2.87	t=7.12, df=118	<0.001	Reject: UC higher
H0.3 Satisfaction	Q7 Sense of Road Ownership	t-test	3.88	2.48	t=12.4, df=118	<0.001	Reject: UC higher

***** H0.2 aggregate: p=0.062. There is no significant difference between in overall result. Drainage sub-domain finding is statistically significant and robust.

Summary: H0.1 (time) rejected UC achieves significantly lower delays and schedule variance on rural road projects. H0.2 (quality aggregate) not rejected at $p<0.05$ due to sub-sample power constraints, but contractor shows large significant advantage on drainage specifically (p=0.004,); supervised UC sites are not significantly different from contractor sites. H0.3 (satisfaction) rejected UC achieves significantly higher road beneficiary satisfaction.

4.11 Cross-Dimensional Synthesis

Time delays and quality outcomes: The 3.8 month procurement overhead for contractor road projects structurally compresses the construction window into the post-monsoon period (Kartik–Falgun). This temporal constraint directly affects road quality: when contractors must complete road formation, drainage placement, and surface work within four months rather than six, drainage detailing the most quality-differentiating sub-domain is the first element to be abbreviated. The UC road UC-09 (Ward 5, SV=1.44) illustrates the inverse mechanism: when UC construction extends into monsoon season, the road suffers water damage before drainage works are complete, requiring rework that further extends delay. For both modalities, the time-quality relationship is mediated by monsoon seasonality: roads caught in construction during Ashadh-Bhadra face compounded time and quality risks regardless of delivery modality.

Quality gap and satisfaction gap: The contractor quality advantage (CON mean RR-IQOC = 70.3 vs UC = 61.7) does not translate into a contractor satisfaction advantage; rather, UC beneficiaries report significantly higher satisfaction (3.65 vs 2.87). This apparent paradox resolves when satisfaction items are disaggregated. Items measuring process participation (Q1: involvement, Q7: ownership) drive the UC satisfaction advantage substantially more than the road quality perception item (Q3: perceived quality). This finding is consistent with Ostrom's (1990) proposition that collective action produces co-production value beyond the technical output beneficiaries who participated in building the road value it more highly even when the technical specification is lower. The practical implication is that targeted drainage supervision to close the quality gap would leave the UC satisfaction advantage structurally intact, since that advantage derives from process rather than output.

4.12 Qualitative-Quantitative Integration

The mixed-methods design requires explicit integration of quantitative findings and KII qualitative themes. Table 4.11 maps each quantitative finding to the KII theme(s) that corroborate, qualify, or contradict it, enabling systematic triangulation across data sources.

Quantitative Finding	**Supporting KII Theme**	**Qualifying/Contradicting Theme**
Contractor procurement overhead 3.8 months	T1: Bid process timeline confirmed by KII-01, KII-02	None contradicting
Drainage quality gap (0.54 vs 0.74)	T2: Supervision deficit at drainage stage (KII-01, KII-05)	T2: Some UC chairs self-taught drainage (KII-08)
UC satisfaction higher (3.65 vs 2.87)	T5: Participation ownership effect (KII-03, KII-04, KII-09)	T5: Female exclusion from UC governance (KII-06, KII-10)

The integration analysis reveals a coherent explanatory narrative. The UC time advantage is the most robustly supported finding: all ten KII respondents confirm the procurement overhead explanation without qualification. The drainage quality disadvantage is the most consequential finding for policy: confirmed by KII respondents with the most technical expertise (KII-01 Municipal Engineer, KII-02 Sub-Engineer, KII-05 DoLI Sub-Engineer) and uncontradicted in qualitative data. The satisfaction finding is strong quantitatively but has an important qualitative qualification: female and Dalit beneficiaries do not share in the UC satisfaction advantage to the same extent as male higher-caste beneficiaries, a pattern that both the survey stratified analysis and KII respondents 06 and 10 confirm explicitly. The sustainability finding is the most methodologically complex: the directional UC advantage is consistent across all six field indicators, but the n=12 sample cannot establish significance for field measures, and the KII data suggest that both modalities suffer from the same post-completion governance void even if UC communities start from a higher maintenance awareness baseline.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This section summarizes the key findings obtained from the analysis conducted in this study. The research compared the construction project performance especially on rural road projects between the two model on Likhu Rural Municipality, focusing on timelines of the project, observing construction quality and level of satisfaction among the beneficiary. Based on the results obtained and discussions of this research study, important conclusions can be drawn which are discussed below:

Objective 1: To compare project completion timelines, and procurement status

The central conclusion is that for rural road projects at Likhu Rural Municipality's typical scale and governance conditions, UC delivery offers better time performance and community satisfaction outcomes, while contractor delivery shows a technical advantage specifically on road drainage design. These conclusions are grounded in statistically significant findings and are consistent with the theoretical predictions of collective action theory and principal-agent theory.

Objective 2: To assess and compare the construction quality based on DoLI specification compliance parameters.

To assess the construction quality checklist was prepared based on rural road standards and scoring was given on different sub-domain based on field observation.

The result indicated that there exists no significant difference in overall. But there seems the critical technical gap in road drainage in UC delivery projects. Although community builders achieve adequate structural and surface quality with minimal supervision.

Objective 3: To analyse road beneficiary community satisfaction levels and participation experiences.

Perception based questionnaire survey was done from the road beneficiary community and RII was used.

The result indicated that level of satisfaction is higher in UC’s model although contractor seems forward in some aspects of technical evaluation. Road usefulness is the highest rated item for

the both case which indicates irrespective of the process rural roads are useful for the beneficiary groups.

5.6 Recommendation

- Strengthen technical supervision for UC projects

  Major weakness of UC is lack of technical expertise so, assign mandatory field supervision by engineers/ overseers. Conduct regular quality inspection.

- Mandatory engineering checks for drainage design

  Drainage was found to be the most critical weakness in UC projects. Make drainage design approval compulsory before execution. Provide standard design guidelines and training to UC members. Ensure site-specific drainage solutions in hilly terrain.

- Capacity building for UC members

  Provide technical training before project execution topic wise like basic road engineering, drainage design, material quality control

- Reform procurement process

  Improvement in procurement inefficiency

  Simplify and digitize procurement procedures

  Ensure timely bidding, approval, and contract award

  Introduce strict timeline enforcement mechanisms

- Adopt hybrid delivery model based on project complexity

  Since UC performs better in time and satisfaction, and contractors in technical quality, local government should use UC for small, simple, low-cost rural roads, and use contractor for technically complex and high-risk projects. This ensures optimal balance between efficiency and quality.

- Introduce Performance-based monitoring system

  Develop a standard monitoring framework using: Time indicators (SV), Quality indicators (RR-IQOC)

  Conduct periodic performance audits

  Link contractor/UC performance with future project eligibility

5.6.1 Recommendations for further studies:

- Expand study to multiple regions
- Include cost performance analysis
- Conduct long-term sustainability study
- Increase technical quality sample size
- Analyze supervision and governance
- Study hybrid UC-contractor models
- Assess socio-economic impacts
- Include gender and inclusion aspects
- Explore digital procurement systems

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APPENDIX I: QUESTIONAIRE (QUANTITATIVE)

HOUSEHOLD BENEFICIARY SURVEY QUESTIONNAIRE
Comparative Analysis: UC vs Contractor Rural Road Projects
Likhu Rural Municipality, Nuwakot District, Nepal

Dear Respondent, I am a student pursuing a Master in Construction Management(MSCoM), currently working on my master's thesis titled." **Comparative Analysis of Users Committee versus Contractor Delivered Public Infrastructure: Rural Road Projects in Likhu Rural Municipality, Nuwakot ".** This thesis aims to **1. To compare project completion timelines, schedule variance, and procurement status 2. To assess and compare the construction quality based on DoLI specification compliance parameters. 3.To analyze road beneficiary community satisfaction levels and participation experiences.** Your expert opinion and valuable input will play a crucial role in achieving the objectives of this research. The collected data will remain strictly confidential and will be used solely for academic purposes. Instructions for completing the questionnaire: Carefully read each questions or statement. Respond based on your knowledge, experience, and observations related to the building construction industry. Your participation in this study is highly appreciated. Thank you for your time and cooperation.

IDENTITY

ID1. Respondent ID:
R-___

ID2. Project Code:
UC-__ / CON-__

ID3. Delivery Modality:
- ☐ User Committee (UC)
- ☐ Contractor

ID4. Ward Number:
- ☐ Ward 1
- ☐ Ward 2
- ☐ Ward 3
- ☐ Ward 4
- ☐ Ward 5
- ☐ Ward 6

SECTION A: RESPONDENT PROFILE

A5. Sex:
- ☐ Male
- ☐ Female
- ☐ Prefer not to say

☐ 1–2 years
☐ 2–4 years
☐ More than 4 years

B2. How frequently do you use this road?
☐ Every day
☐ 3–5 times per week
☐ 1–2 times per week
☐ A few times per month
☐ Rarely

B3. What is the primary purpose for using this road?
☐ Agricultural produce / inputs transport
☐ Health access
☐ Education access
☐ Market / commercial activities
☐ Government / administrative purposes
☐ Social / community purposes

B4. How has your road access changed since the road was built/improved?
☐ Significantly improved
☐ Somewhat improved
☐ No change
☐ Worse than before

B5. Approximately how much time do you save per trip compared to before?
☐ Less than 15 minutes
☐ 15–30 minutes
☐ 31–60 minutes
☐ More than 60 minutes
☐ No time saving

B6. Is the road passable during the monsoon season?
☐ Always passable
☐ Mostly passable
☐ Partially passable
☐ Frequently impassable

SECTION C: COMMUNITY PARTICIPATION

C1. Were you informed about this project before construction started?
☐ Fully informed and consulted
☐ Informed but not consulted
☐ Informed only after construction started
☐ Not informed at all

C2. Did you or any household member attend project meetings?
☐ Yes, attended
☐ Not invited
☐ Was invited but could not attend

☐ Above NPR 30,000

SECTION B: ROAD USE & ACCESS

B1. How long have you been using this road?
☐ Less than 1 year

C3. What type of contribution did your household make to the project?

- ☐ Labour
- ☐ Materials
- ☐ Land (Right of Way)
- ☐ Multiple contributions
- ☐ None

C4. Were your household's concerns or suggestions addressed during the project?

- ☐ Yes, fully addressed
- ☐ Partially addressed
- ☐ No feedback mechanism
- ☐ Not addressed at all

C5. How would you describe the inclusion of women and marginalised groups in project decisions?

- ☐ Actively included in decisions
- ☐ Nominally present but not involved
- ☐ Present but excluded from decisions
- ☐ Not included at all
- ☐ Don't know

C6. How would you rate your community's overall level of participation in this project?

☐1 ☐2 ☐3 ☐4 ☐5

(1 = Very Low participation | 5 = Very High participation)

SECTION D: PERCEIVED CONSTRUCTION QUALITY

Rate the quality of each construction element on a scale of 1 to 5 (1 = Very Poor, 5 = Very Good).

D1. Surface / Carriageway Quality:

☐1 ☐2 ☐3 ☐4 ☐5

(1 = Very Poor / Very Dissatisfied | 5 = Very Good / Very Satisfied)

D2. Drainage Quality (side drains, catch-water drains):

☐1 ☐2 ☐3 ☐4 ☐5

(1 = Very Poor / Very Dissatisfied | 5 = Very Good / Very Satisfied)

D3. Culvert Quality:

☐1 ☐2 ☐3 ☐4 ☐5

(1 = Very Poor / Very Dissatisfied | 5 = Very Good / Very Satisfied)

D4. Slope Protection / Retaining Structures:

☐1 ☐2 ☐3 ☐4 ☐5

(1 = Very Poor / Very Dissatisfied | 5 = Very Good / Very Satisfied)

D5. Road Width (adequacy for intended use):

☐1 ☐2 ☐3 ☐4 ☐5

(1 = Very Poor / Very Dissatisfied | 5 = Very Good / Very Satisfied)

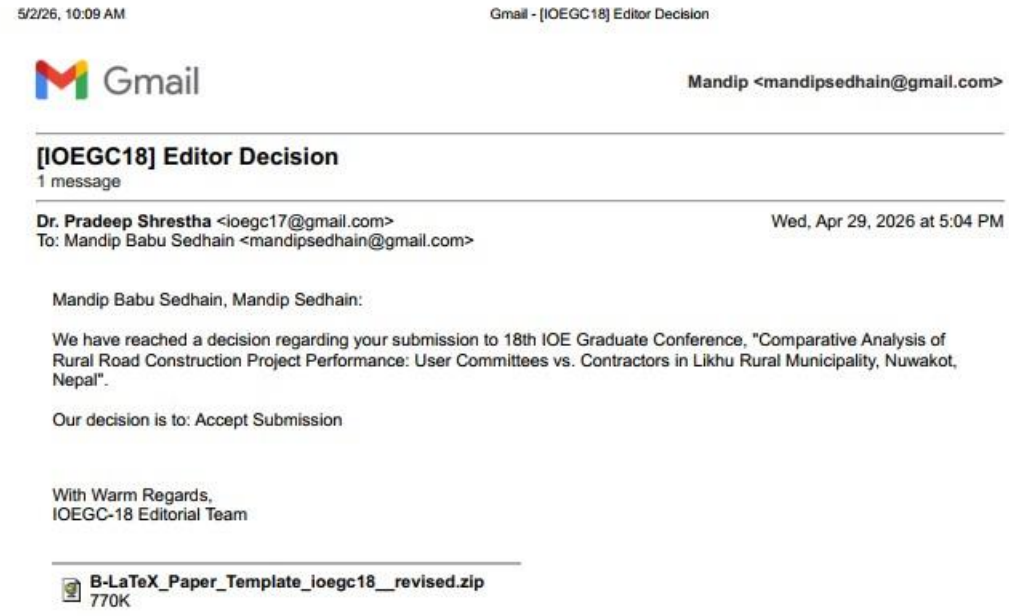
D6. Overall Perceived Construction Quality:

☐1 ☐2 ☐3 ☐4 ☐5

(1 = Very Poor / Very Dissatisfied | 5 = Very Good / Very Satisfied)

SECTION E: BENEFICIARY SATISFACTION

APENDIX II: ACCEPTANCE MAIL FROM 18TH IOE GRADUATE CONFERENCE



5/2/26, 10:09 AM Gmail - [IOEGC18] Editor Decision

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Mandip <mandipsedhain@gmail.com>

[IOEGC18] Editor Decision
1 message

Dr. Pradeep Shrestha <ioegc17@gmail.com> Wed, Apr 29, 2026 at 5:04 PM
To: Mandip Babu Sedhain <mandipsedhain@gmail.com>

Mandip Babu Sedhain, Mandip Sedhain:

We have reached a decision regarding your submission to 18th IOE Graduate Conference, "Comparative Analysis of Rural Road Construction Project Performance: User Committees vs. Contractors in Likhu Rural Municipality, Nuwakot, Nepal".

Our decision is to: Accept Submission

With Warm Regards,
IOEGC-18 Editorial Team

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APENDIX III: ORIGIALITY REPORT

iThenticate

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PAPER NAME

Comparative Analysis of Users Committee versus Contractor Delivered Public Infrastructure: Rural Road Projects in Likhu Rural Municipality, Nuwakot

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Mandip Babu Sedhain

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92055 Characters

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