

# A Study on Bidding Trend and Performance of Construction Projects: A Case Study of Water Supply Projects in Koshi Province, Nepal

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## Abstract

Public procurement regulations strongly influence construction project outcomes, particularly in the water supply sector of Nepal. To address contractor over-commitment and aggressive low bidding, the Government of Nepal enacted the 11<sup>th</sup> and 12<sup>th</sup> amendments to the Public Procurement Regulations (PPR), 2064, limiting each contractor to a maximum of five concurrent projects. This study evaluates the impact of this regulatory change on bidding behavior, competition, and project performance in water supply projects implemented by federal-level offices of the Department of Water Supply and Sewerage Management (DWSSM) within Koshi Province. A dataset of 108 projects (45 before amendment, n = 63 after amendment) was analyzed using quantitative and descriptive statistical methods to compare pre- and post-amendment periods. Key aspects examined include bidder participation, bid price trends relative to engineer's estimates, project time performance, and contractor market concentration. Results indicate a statistically significant decline in average bidder numbers from 4.49 to 2.78 (38.1% reduction,  $p < 0.001$ ), while average bid discounts fell from 28.66% to 11.80% (58.84% reduction,  $p < 0.001$ ), reflecting considerably more realistic pricing. Project time performance improved dramatically, with mean delay for completed projects falling from 488 days to 48 days (90.1% reduction), and the proportion of projects requiring Extension of Time (EoT) declining from 86.7% to 9.5%. The Herfindahl-Hirschman Index (HHI) decreased from 1,850 to 1,240, indicating measurable market deconcentrating, while unique contractor participation increased from 34 to 55 firms. The findings suggest that regulatory interventions can improve project execution without encouraging underbidding, but sustained monitoring is necessary to prevent collusive bid clustering and single-bidder concentration for large contracts.

*Keywords:* Public Procurement Regulation, Bidding Trends, Water Supply Projects, Low Bidding, Construction Delays, Procurement Policy, Project Performance.

## 1. Introduction

### 1.1 Background

Construction is one of the most critical sectors contributing to the economic growth of nations. In Nepal, the construction sector receives approximately 60% of the national development budget through contractors and contributes 10–11% to the country's Gross Domestic Product (FCAN, 2020). Public procurement in Nepal is governed by the Public Procurement Act, 2063 (PPA, 2063) and the Public Procurement Regulations, 2064 (PPR, 2064), which provide the comprehensive legal framework for acquiring goods, works, and services by public entities. The Department of Water Supply and Sewerage Management (DWSSM), under the Ministry of Water Supply, is a key implementing agency responsible for planning and executing water, sanitation, and hygiene (WASH) infrastructure across Nepal. DWSSM annually allocates approximately NPR 15 billion for construction of water supply and sewerage projects across the country.

Projects are competitively awarded through National Competitive Bidding (NCB) or International Competitive Bidding (ICB) via the government's electronic Government Procurement (e-GP) portal ([www.bolpatra.gov.np](http://www.bolpatra.gov.np)). Under NCB, construction works valued above NPR 20 million are procured through Single Stage Double Envelope (1S2E) procedures that require prequalification of contractors, while smaller works below NPR 20 million use the Single Stage Single Envelope (1S1E) procedure. Prior to the 11th amendment, PPR, 2064 placed no restriction on the number of contracts a contractor could simultaneously hold, enabling aggressive multi-contract strategies that often resulted in resource overextension and chronic project delays (KC, 2019; Khadka, 2021).

To address systemic problems of contractor over-commitment and aggressive low bidding, the Government of Nepal enacted the 11th amendment to PPR, 2064, published on 2078/12/03 BS (March 2022 AD), followed by the 12th amendment on 2079/03/20 BS. These amendments introduced Rule 65(3), restricting each contractor to a maximum of five concurrent projects. The 11th amendment restricted contractors from bidding when they already held five or more ongoing contracts; the 12th amendment retained the five-project ceiling but clarified that contractors may bid but cannot sign more than five contracts simultaneously. This regulatory reform represents a landmark intervention in Nepal's public construction procurement landscape. This study evaluates the impact of these amendments using a dataset of 108 water supply projects from five federal implementing offices within Koshi Province.

### ***1.2 Statement of the Problem***

The success of a construction project is evaluated by completion within the triple constraints of cost, time, and quality. In Nepal, chronic delays are pervasive, with an average implementation delay of approximately three years across construction projects (Khadka, Kalyan, 2021). Prior studies showed that a significant proportion of bidders concentrated bids at 20–35% below engineer's estimates to secure maximum contracts (KC, 2019), triggering the 'winner's curse': contractors underestimate costs, face financial distress mid-execution, and consequently delay or abandon projects. Under the previous regulatory framework, there was no mechanism preventing a single contractor from simultaneously holding an unlimited number of contracts. Although the 11th amendment aimed to address these issues, limited empirical research has evaluated its actual impact on bidding behavior, competition, project performance, and market structure, particularly in the water supply sector.

### ***1.3 Research Objectives***

The overall objective of this study is to analyze the changes in bidding trends and project performance in DWSSM water supply projects due to the 11th and 12th amendments in PPR, 2064. The specific objectives are:

- (i) To analyze the bidding trend of water supply related contracts under DWSSM before and after the 11th amendment and assess whether changes are statistically significant;
- (ii) To assess the impact of the legislative change on the timely performance and delay of projects; and
- (iii) To investigate contractor market concentration before and after the amendment.

### ***1.4 Scope and Limitations***

This study is limited to data from federal project offices of DWSSM operating within Koshi Province, covering five implementing offices. Although contract performance can be evaluated across cost, time, and quality dimensions, this research assesses performance primarily through cost and time indicators due to data availability constraints. The study relies entirely on secondary administrative records; accordingly, data quality and potential administrative errors are acknowledged as limitations. The study period of approximately three and a half years since amendment implementation means that caution is warranted in distinguishing amendment-specific effects from other external factors such as broader economic conditions, COVID-19 aftermath, or changes in contractor capacity in the region. The rationale for focusing on Koshi Province is data accessibility: all five DWSSM federal implementing offices in this province provided complete procurement records, making it a coherent and representative study area within Nepal's water supply sector.

## **2. Literature Review**

### ***2.1 Public Procurement Framework in Nepal***

Public procurement is defined as the government's mechanism to acquire goods, works, and services needed for public programs using public funds (Khan, 2018). The core universally accepted principles include transparency, efficiency, fairness, value for money, and integrity—all enshrined in Nepal's PPA, 2063 and PPR, 2064 (GoN/PPMO, 2007). The Nepal Public Procurement Strategic Framework (NPPSF) has progressively sought to enhance transparency and competitiveness in procurement, including the introduction of the e-GP system for online bidding. However, compliance challenges and weak enforcement have persisted (PPMO/GoN, 2007). Public works in Nepal are typically awarded to the lowest responsive bidder under the NCB method. The PPA, 2063 and PPR, 2064 allow various procurement methods including Direct Purchase, Sealed Quotation, National Competitive Bidding (NCB), and International Competitive Bidding (ICB), with the method determined by contract value thresholds. For construction works above NPR 20 million, 1S2E under NCB is mandated with contractor prequalification. In construction projects, analytical tools are increasingly used as decision-support mechanisms before procurement (Bhattarai & Suwal, 2022). This highlights the importance of data-driven approaches in selecting project components and improving project performance.

### **2.2 Low Bidding and Its Consequences**

Low bidding is the practice of submitting the minimum possible price to secure a contract through the award criterion of lowest responsive bid. While it promotes price competition and short-term budgetary savings, it harbors significant drawbacks including delays in meeting contract duration, increment of final project cost through high variations, tendency to compromise quality, and adversarial relationships among contracting parties (Thomas, 2009; Loannou & Leu, 2015). The European Union's 2014 Public Sector Directive acknowledges that the lowest price is not always the best value for money, mandating evaluation based on 'most economically advantageous tender'.

In Nepal, previous studies revealed that the majority of bidders submitted prices 20–35% below engineer's estimates to secure maximum contracts (KC, 2019; Bista & Dahal, 2018). Khadka (2021) confirmed that low bidding was one factor behind project delays, though not the only factor. Mishra and Aithal (2020) quantified the financial impact of time overrun in Nepal's small towns water supply projects. The 'winner's curse' phenomenon, where winning contractors underestimate costs (Capen, Clapp & Campbell, 1971) and face financial distress is well-documented as a primary driver of construction delays in developing countries (Maharjan et al., 2023).

### **2.3 Procurement Regulatory Reforms**

Internationally, several procurement reform strategies have been employed to mitigate abnormally low tenders. Feng and Guo (2025) identified increasing use of data-driven bid evaluation methods in China, while Zhang et al. (2025) found that contractors' bidding strategies in Singapore's public sector are significantly influenced by workload, competition intensity, and prior experience. The 'Average Bidding Method' adopted in some countries awards contracts based on the average of submitted bids rather than the lowest, discouraging extreme underbidding (Leu & Loannou, 2015; Michael & Awwad, 2018), although this method has no provision in Nepal's current PPA/PPR.

Shakya and Panta (2023) conducted the most directly comparable study in Nepal, examining the impact of the PPR 11th amendment on DUDBC building construction projects. They reported a reduction in average bidders from 8.1 to 3.5 and average percentage below estimate from 26.6% to 16.1% for large projects, confirming significant behavioral change. However, their study was limited to urban building construction, which differs substantially from rural water supply infrastructure in terms of topography, contractor availability, project complexity, and procurement dynamics. This study addresses the unexplored water supply sector dimension.

### **2.4 Contractor Market Concentration**

Market concentration in construction procurement is a key indicator of competitive health. The Herfindahl-Hirschman Index (HHI), calculated as the sum of squared market shares, is the standard measure: markets with HHI below 1,500 are considered unconcentrated; 1,500–2,500 moderately concentrated; and above 2,500 highly concentrated (U.S. Department of Justice, 2010). High concentration can indicate barriers to entry for smaller firms, risk of implicit collusion, and reduced-price competition.

### 3. Research Methodology

#### 3.1 Research Design

This study adopts a quantitative, retrospective comparative research design. The methodological flow is presented in Figure 1. The cutoff date of 2078-12-03 BS (11th amendment effective date) was used to classify projects into two periods: Before Amendment (bid invitation date < 2078-12-03 BS) and After Amendment (bid invitation date ≥ 2078-12-03 BS).

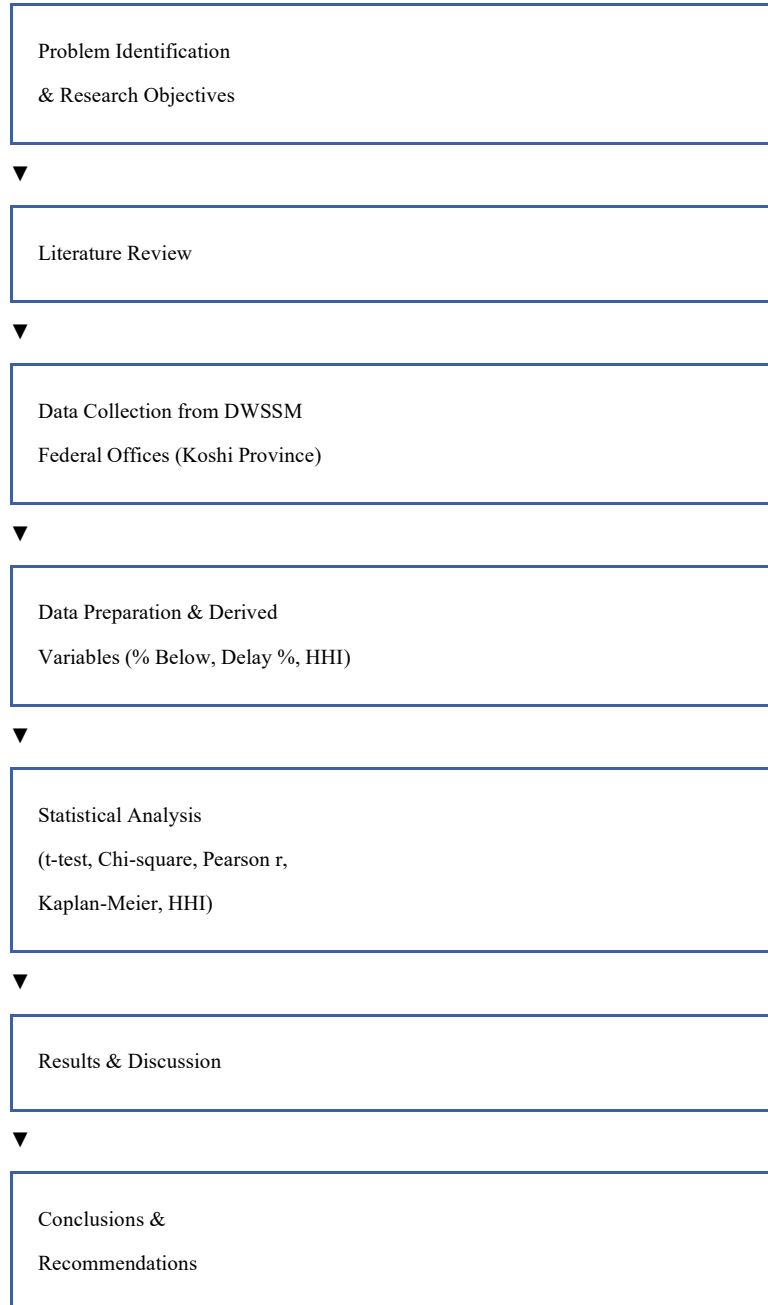


Figure 1. Methodological Flow Process of the Study

#### 3.2 Study Area and Data Collection

The study covers five federal-level implementing offices within Koshi Province, Nepal: FWSSMP Dhankuta, FWSSMP Khotang, FWSSMP Ilam, RPMO Itahari, and FWSSMP Biratnagar. Secondary data were collected from official procurement records, contract registers, and project completion reports. A total of 108 water supply

projects spanning bid invitation years from 2074 BS to 2082 BS were compiled (n = 45 before amendment; n = 63 after amendment). Data variables include: bid invitation date, estimated amount, contract amount, number of bidders, agreement date, initial and revised completion dates, actual completion date, physical progress percentage, contractor name, and procurement category (1S1E or 1S2E).

Table 1. Research Matrix

Research Objective	Input Data	Data analysis Tools	Data Source	Expected Outcomes
Analyze bidding trends before/after PPR amendment	Bidding data, estimated & bid amount, no. of contracts, bid size type	Statistical tests (U & t-test, Chi-square, Pearson r, frequency distribution)	DWSSM project records of Koshi Province	Bid trend, comparisons of % below, very high/low bid, no. of bidder
Assess impact on timely performance/delay of projects	Work order data, Actual completion date, EoT records	Delay calculation, U, t-test, chi-square, Kaplan-Meier survival analysis	Contract completion records	Performance of contractor, delay reduction, trend & delay relation
Investigate contractor market concentration	No. of bidders, single bidder, JV data, bidders progress, current status	HHI, CR4, CR8 Count, Single bidder analysis	Contract data Projects under DWSSM within Koshi Province	Shift in market structure and participation, single bidder contracts

### 3.3 Derived Variables and Analysis Methods

Key derived variables were computed as: (i) % Below Estimate = [(Estimated Amount – Contract Amount) / Estimated Amount] × 100; (ii) Delay Days = Actual Completion Date – Initial Completion Date (for completed projects); (iii) Delay % = (Delay Days / Original Contract Duration) × 100; (iv) HHI = Σ(market share of contractor i)<sup>2</sup> across all contractors. Statistical methods applied include independent-samples t-tests and Mann-Whitney U tests for comparing means/medians between periods, chi-square tests for proportional comparisons, Pearson correlation and linear regression for bidder-price and bid-delay relationships, Kaplan-Meier survival analysis for time-to-completion comparisons, and HHI with concentration ratios (CR4, CR8) for market structure assessment.

## 4. Results and Discussion

### 4.1 Bidding Competition and Price Trends

#### 4.1.1 Overall Comparison Before and After Amendment

Table 2. Overall Bidding Trends Before and After Amendment

Metric	Before (n=45)	After (n=63)	Difference	p-value
Avg. Number of Bidders	4.49	2.78	↓ 38.1%	<0.001
Avg. % Below Estimate	28.66%	11.80%	↓ 58.84%	<0.001
Very High Bids (< 5%)	4.4%	23.8%	↑ 435.7%	0.006
Low Bids (≥ 20%)	84.4%	19.0%	↓ 77.4%	<0.001

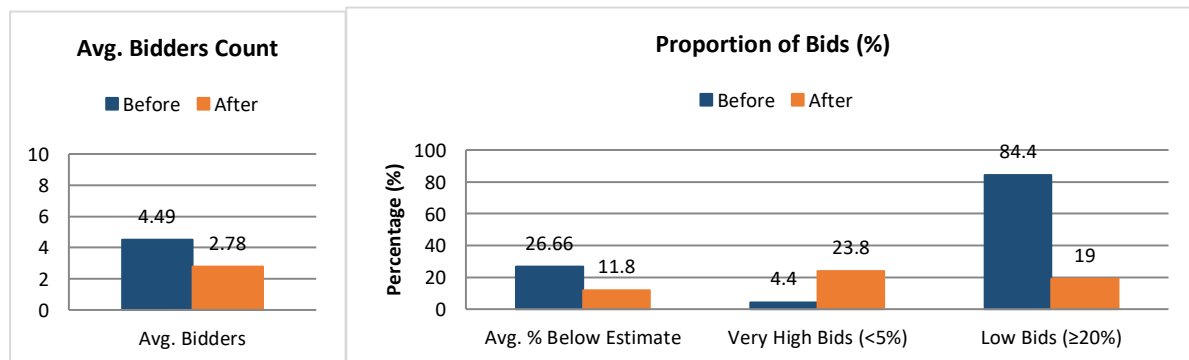


Figure 2. Overall Bidding Trends Before and After Amendment

The overall results in Table 2 reveal a dramatic and statistically significant shift in bidding behavior. The average number of bidders decreased by 38.1% from 4.49 to 2.78 ( $t = 4.38$ ,  $df = 77.6$ ,  $p < 0.001$ ), a direct consequence of the policy restricting contractor with five or more ongoing projects from bidding. The average percentage below estimate fell from 28.66% to 11.80%, a reduction of 58.84%, indicating a decisive shift toward more realistic pricing. The proportion of very high bids (within 5% of the estimate) increased sharply from 4.4% to 23.8% ( $\chi^2 = 7.44$ ,  $p = 0.006$ ). While this may reflect improved cost estimation alignment, this pattern merits careful surveillance by PPMO as clustering of bids near the estimate can signal bid rigging practices. Conversely, low bids ( $\geq 20\%$  below) reduced dramatically from 84.4% to 19.0% ( $\chi^2 = 45.15$ ,  $p < 0.001$ ) with 95% confidence intervals (CI), which is the most significant positive outcome as extremely low bids are strongly associated with the 'winner's curse' and subsequent project delivery failures.

#### 4.1.2 Analysis by Project Size and Type

Table 3. Bidding Trends by Project Size and Procurement Type

Project Size/Type	Period	No. of Contracts	Avg. Bidders	Avg. % Below	Very High (< 5%)	Low Bids ( $\geq 20\%$ )
Small (1S1E, < NPR 20M)	Before Amendment	0	-	-	-	-
	After Amendment	16	3.63	17.54%	18.8%	43.8%
Large (1S2E, $\geq$ NPR 20M)	Before Amendment	45	4.49	28.66%	4.4%	84.4%
	After Amendment	47	2.49	9.84%	25.5%	10.6%

For large projects (1S2E  $\geq$  NPR 20 million), the amendment produced the most pronounced effects: average bidders fell from 4.49 to 2.49 (44% decline,  $t = 4.95$ ,  $df = 90$ ,  $p < 0.001$ ) and average percentage below estimate dropped from 28.66% to 9.84% (66% reduction,  $t = 9.25$ ,  $df = 90$ ,  $p < 0.001$ ). The proportion of very high bids for large projects increased from 4.4% to 25.5% ( $\chi^2 = 7.92$ ,  $p = 0.005$ ). Low bids plummeted from 84.4% to just 10.6% for large projects ( $\chi^2 = 50.31$ ,  $p < 0.001$ ), confirming that aggressive underbidding in the high-value contract segment has been largely eliminated. It is noted that no 1S1E (Small) contracts existed before the amendment in the studied dataset, as DWSSM offices in Koshi Province focused primarily on large infrastructure contracts in the pre-amendment period. For small projects (1S1E) after the amendment, the average number of bidders (3.63) remains higher than for large projects after (2.49), and 43.8% of small projects still receive low bids, suggesting that the small contract segment continues to experience healthy price competition.

#### 4.1.3 Bidding Trends by Implementing Office

Table 4. Bidding Trends by Implementing Office

Office	Period	No. of Contracts	Avg. Bidders	Avg. % Below	Very High (< 5%)	Low Bids ( $\geq 20\%$ )
FWSSMP, Dhankuta	Before	6	4.00	29.5%	0.0%	100.0%
	After	40	2.88	12.7%	17.5%	22.5%
FWSSMP, Khotang	Before	9	2.89	22.1%	22.2%	66.7%
	After	5	1.20	2.7%	80.0%	0.0%
FWSSMP, Ilam	Before	9	5.67	31.0%	0.0%	100.0%
	After	10	3.90	16.7%	10.0%	30.0%
RPMO, Itahari	Before	10	4.70	21.6%	0.0%	70.0%
	After	2	2.00	11.2%	0.0%	0.0%
FWSSMP, Biratnagar	Before	11	4.91	37.9%	0.0%	90.9%
	After	6	1.83	5.1%	50.0%	0.0%

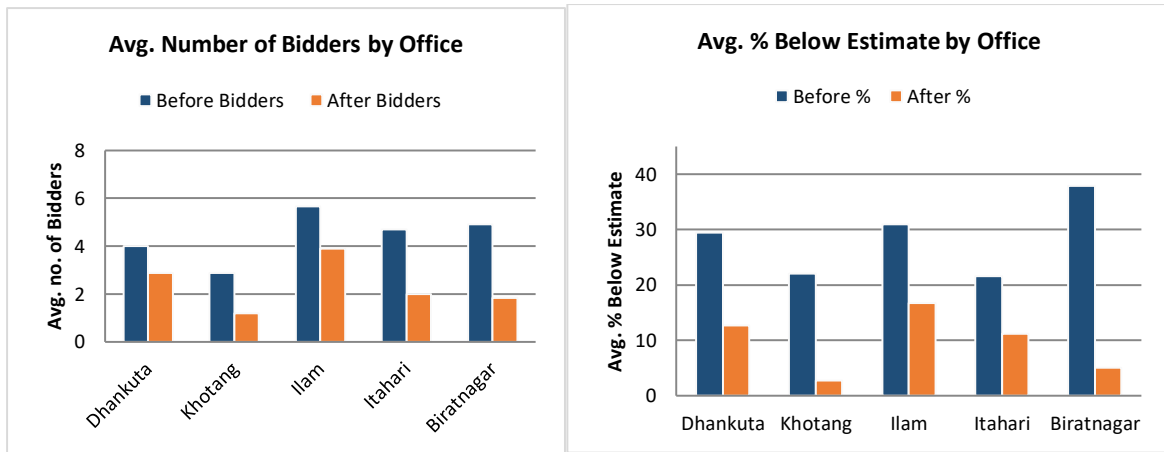


Figure 3. Average Number of Bidders and % Below Estimate by Implementing Office

All five implementing offices show consistent directional trends: reduced average bidders and percentage below estimate, increased very high bids, and reduced low bids. FWSSMP Khotang shows the largest increase in very high bids (from 22.2% to 80%), warranting focused monitoring. FWSSMP Biratnagar shows the largest reduction in percentage below estimate (from 37.9% to 5.1%). The uniformity of results across geographically distinct offices confirms that the policy effect is widespread across the water supply sector within Koshi Province and is not confined to any particular region or local market condition.

#### 4.1.4 Correlation and Regression Analysis

Table 5. Correlation Between Number of Bidders and % Below Estimate

Period	Correlation Coefficient (r)	p-value
Before Amendment	0.25	0.25
After Amendment	0.50	0.50
Overall	0.51	0.51

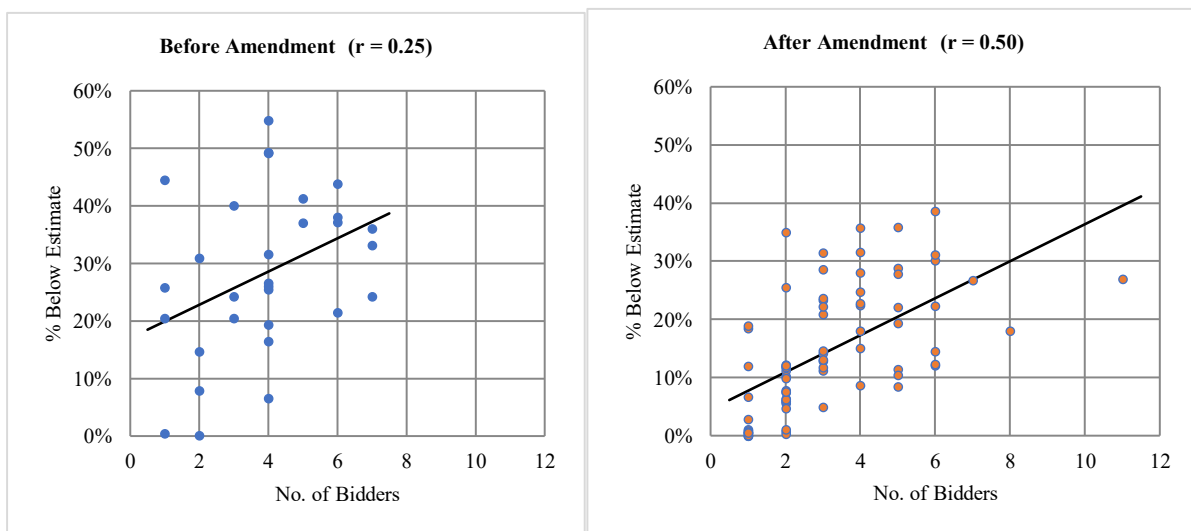


Figure 4. Correlation Between Number of Bidders and % Below Estimate (Before and After Amendment)

The positive correlation confirms that more bidders are associated with higher bid discounts, consistent with economic theory. The correlation strengthened notably after the amendment ( $r = 0.50, p < 0.001$  vs.  $r = 0.25, p = 0.093$  before), suggesting that competition now plays a more decisive role in pricing behavior. Linear regression yielded the following equations — Overall:  $\% \text{ Below} = 7.48\% + 3.25\% \times (\text{No. of Bidders}), R^2 = 0.265$ ; Before amendment:  $\% \text{ Below} = 22.61\% + 1.35\% \times (\text{No. of Bidders}), R^2 = 0.064$ ; After amendment:  $\% \text{ Below} = 4.38\% +$

$2.67\% \times (\text{No. of Bidders})$ ,  $R^2 = 0.250$ . Each additional bidder after the amendment is associated with a 2.67 percentage point increase in discount. The reduction of approximately 1.72 bidders per project theoretically accounts for a 4.57 percentage point decline through competition effects alone, with the remainder attributable to behavioral shifts toward more conservative bidding strategies.

**4.1.5 Year-wise Bidding Trends**

Table 6. Year-wise Bidding Trend Summary

Bid Year (BS)	Period	Avg. No. of Bidders (Yearly)	Avg. % Below Estimate (Yearly)
2074	Before	2.5	28.64%
2075	Before	4.4	26.52%
2076	Before	3.6	25.66%
2077	Before	5.2	26.82%
2078	Before/After	4.4	33.0%
2079	After	1.6	6.41%
2080	After	2.0	11.89%
2081	After	2.3	15.96%
2082	After	2.4	12.76%

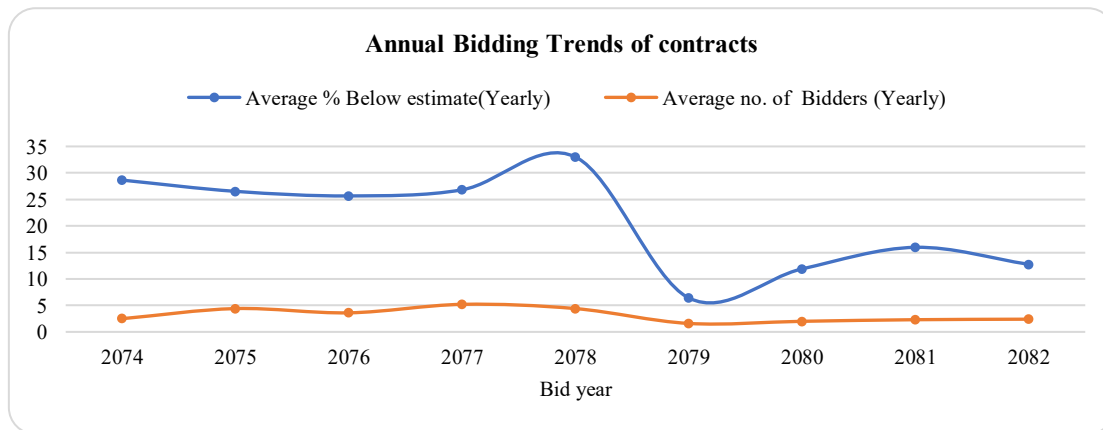


Figure 5. Annual Bidding Trends of contracts showing average % below and average number of bidders

The year-wise trend in Table 6 shows a clear structural break around the amendment date (2078-12-03 BS). Both average bidders and percentage below estimate decline progressively after the amendment and remain at lower levels in subsequent years. This time-series evidence supports a causal interpretation that the amendment rather than other external factors drove the observed changes in procurement behavior.

**4.2 Impact on Project Timely Performance/Delay**

**4.2.1 Overall Delay Analysis for Completed Projects**

Table 7. Delay Analysis for Completed Projects

Metric	Before (N=39)	After (N=19)	Difference	p-value
Median Delay (days)	476	-4	-480 days	<0.001
Mean Delay (days)	488	48	-440 days	<0.001
Std. Dev (days)	240	154	-	-
Median Delay %	52.7%	-3.0%	-55.7%	<0.001

Metric	Before (N=39)	After (N=19)	Difference	p-value
Mean Delay %	64.1%	0.5%	-63.6%	<0.001
Projects with Zero Delay	0 (0%)	13 (68.4%)	+ 68.4%	<0.001

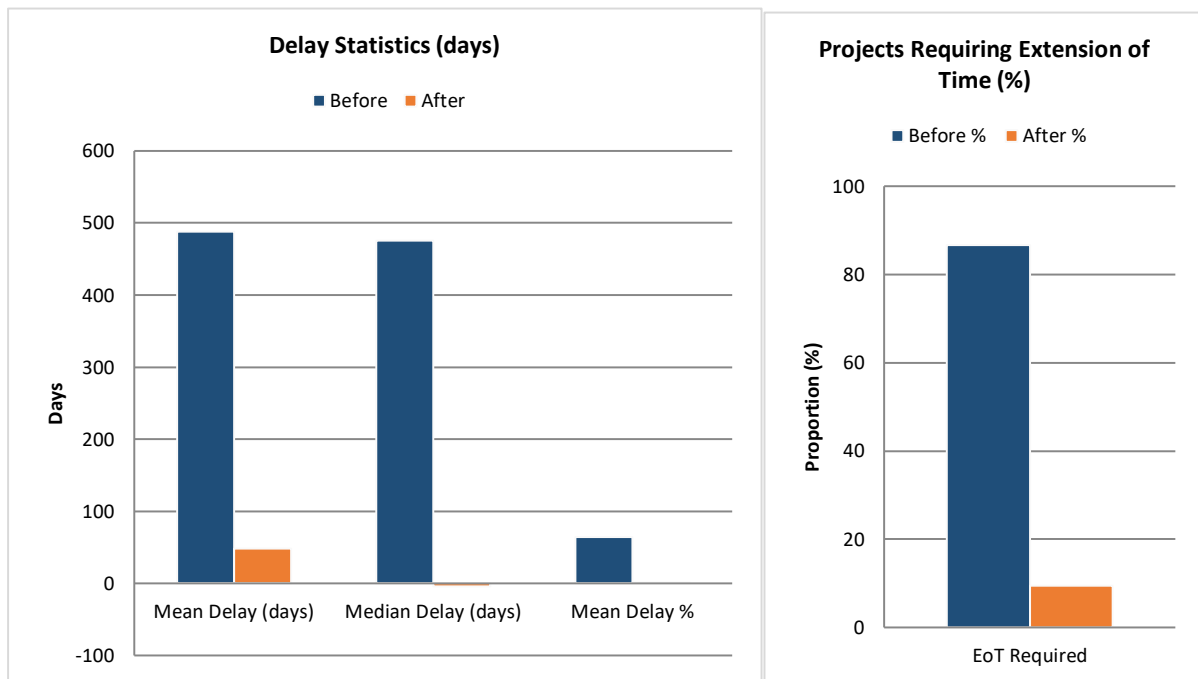


Figure 6. Delay Analysis for Completed Projects — Overall and by Implementing Office

The results demonstrate a dramatic improvement in project timeliness after the 11th amendment. The median delay fell from 476 days to -4 days (projects completed ahead of schedule), and the mean delay dropped from 488 to 48 days — a 90.1% reduction (Welch's  $t = 7.28$ ,  $p < 0.001$ ). The median delay percentage relative to original contract duration decreased from 52.7% to -3.0%. Notably, 68.4% of post-amendment projects were completed with zero delay or ahead of schedule, compared to none before with 95% confidence intervals (CI). These improvements confirm the policy's core objective: contractor limited to five concurrent projects can better allocate resources and fulfill contractual timelines. It is acknowledged that after-period completed projects tend to be more recent and potentially shorter-duration contracts, which may partly explain lower delays independent of the amendment effect. Nonetheless, the magnitude and statistical significance of the improvements strongly support the amendment's impact.

#### 4.2.2 Delay Analysis by Project Size

Table 8. Delay Statistics by Project Size (Completed Projects)

Project Size	Period	N	Median Delay (days)	Mean Delay (days)	Median Delay %
Small (1S1E)	After Amendment	5	-5	-22	0.0%
Large (1S2E)	Before Amendment	39	476	488	100.0%
Large (1S2E)	After Amendment	14	-4	73	42.9%

For large projects (1S2E), the reduction in median delay from 476 days to -4 days is highly significant (Mann-Whitney U,  $p = 0.000002$ ), confirming that the amendment had a meaningful impact on reducing delays for large-scale projects. All 39 before-amendment large projects experienced delays (100% delayed), while only 42.9% of the 14 after-amendment large projects were delayed. Small projects after the amendment show the best performance, with a mean of -22 days (early completion), consistent with their simpler scope and easier resource mobilization.

### 4.2.3 Extension of Time (EoT) Analysis

Table 9. Projects Requiring Extension of Time

Period	Total Projects	With EoT	Proportion
Before Amendment	45	39	86.7%
After Amendment	63	6	9.5%

The proportion of projects requiring EoT collapsed from 86.7% to 9.5% ( $\chi^2 = 52.4$ ,  $p = 0.05$ ), a 77.2 percentage point reduction. This extraordinary result signifies that contractors are now far more capable of adhering to original schedules. Fewer EoT requests reduce administrative burden, dispute risk, and public expenditure associated with prolonged project implementation.

### 4.2.4 Relationship between Bidding trend and Delay

Table 10. Correlation Between % Below Estimate and Delay Days

Period	Correlation Coefficient (r)	t-statistic	Interpretation
Before Amendment	0.37	2.158	Moderate positive
After Amendment	0.43	2.218	Moderate positive
Overall	0.38	2.986	Moderate positive

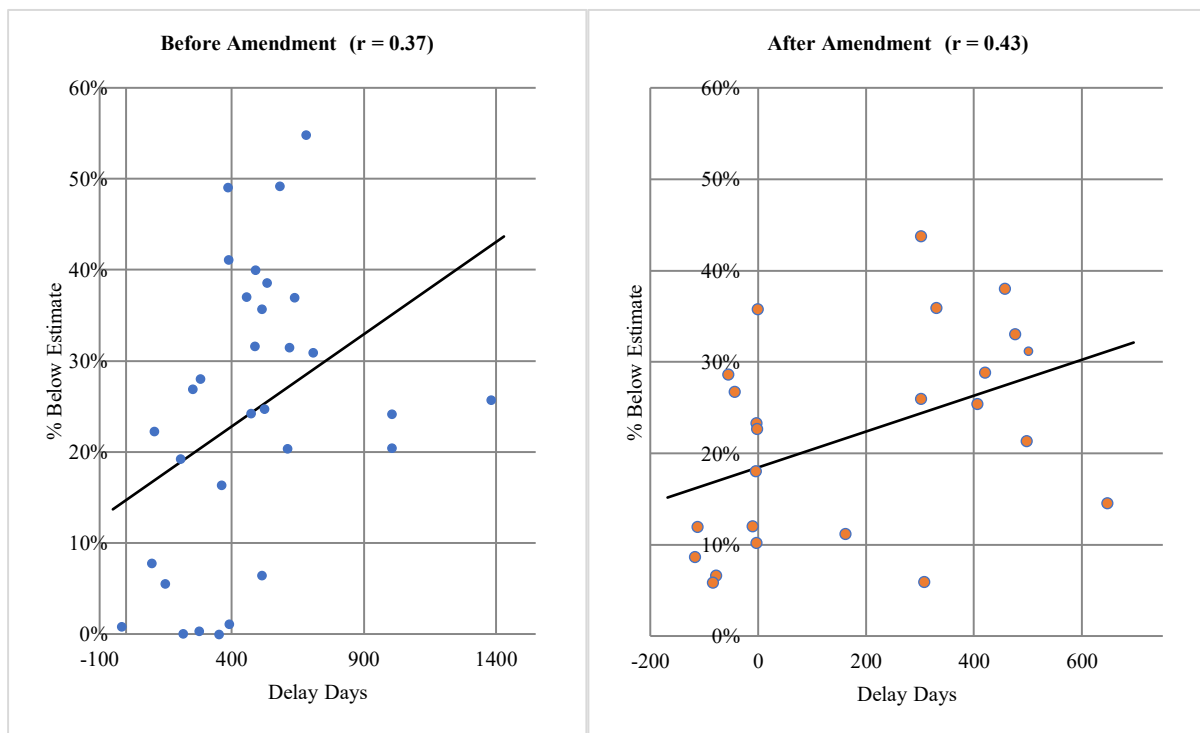


Figure 7. Trend line diagram showing correlation between delay days & % below engineers estimate Before and After Amendment

The positive correlation (overall  $r = 0.38$ ,  $p = 0.004$ ) confirms the 'winner's curse' hypothesis: projects with higher bid discounts experience longer delays. The correlation strengthened after the amendment ( $r = 0.427$  vs.  $0.372$  before), suggesting that the few projects still receiving aggressive bids face even greater delay risk under the new procurement environment. Kaplan-Meier survival analysis confirmed a statistically significant reduction in time to completion (log-rank  $\chi^2 = 45.16$ ,  $df = 1$ ,  $p < 0.001$ ), with the median survival time (time by which 50% of projects are complete) decreasing from 1,227 days before the amendment to 286 days after — a reduction of 941 days (76.7%). By reducing the incidence of extreme low bids, the amendment has thus indirectly contributed to faster project completion.

### 4.2.5 Physical Progress Analysis

Table 11. Physical Progress (%) by Period and Project Status

Status	Period	N	Mean Progress
Completed	Before	39	96.6%
	After	19	95.5%
Running	Before	6	82.5%
	After	44	59.1%
Overall	Before	45	94.7%
	After	48	75.2%

For completed projects, physical progress is near 100% in both periods (95.5% vs. 96.6%), as expected. For running projects, mean physical progress improved from 59.1% (after, many being recent contracts) to 82.5% (before running projects). The overall improvement in contractor adherence to schedules reflects better contractor focus and resource allocation under the new policy. The lower mean progress for after-period running projects (59.1%) is expected given that many are recent contracts not yet near completion.

### 4.3 Contractor Market Concentration

#### 4.3.1 Market Concentration Indices

Table 12. Market Concentration Before and After Amendment

Metric	Before Amendment	After Amendment
Total Contract Amount (NPR)	11,788,210,965	6,079,243,166
Total No. of Contractors (incl. JV members)	56	53
Unique Contractors	34	55
Herfindahl-Hirschman Index (HHI)	1,850	1,240
CR4 (Top 4 Contractors' Share)	46.8%	25.3%
CR8 (Top 8 Contractors' Share)	63.2%	43.1%
Avg. Contracts per Contractor	1.32	1.15
Contractors with $\geq 3$ Contracts	17.64%	5.45%
Single-Bidder Contracts (Large contracts)	8.9%	29.8%

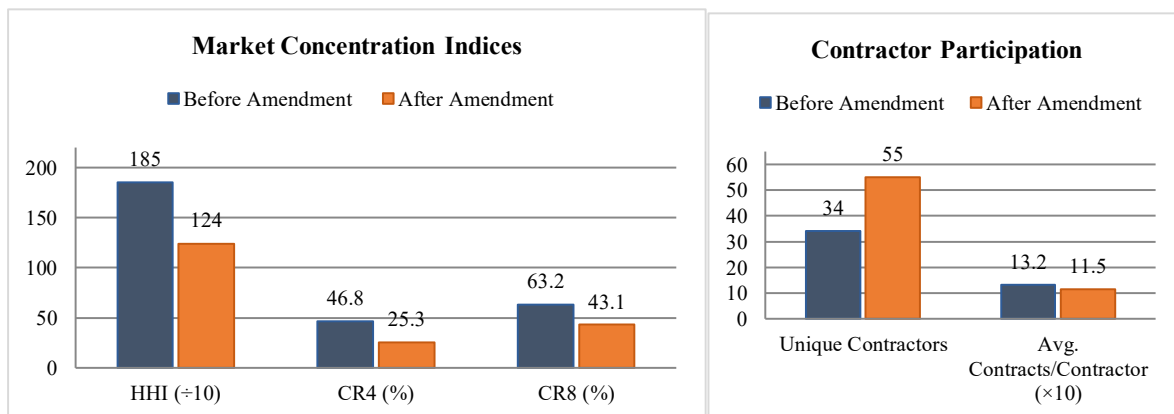


Figure 8. Market Concentration Indices and Contractor Participation

The HHI decreased from 1,850 (moderately concentrated, per U.S. Department of Justice guidelines) to 1,240 (unconcentrated, below the 1,500 threshold). The top four contractors' cumulative market share (CR4) declined from 46.8% to 25.3%, and the top eight share (CR8) fell from 63.2% to 43.1%. The number of unique active contractors increased from 34 to 55, with the proportion of contractors holding only one contract rising from 52.94% to 65.45% and those holding three or more contracts falling from 17.64% to 5.45%. These metrics collectively confirm that the amendment has achieved meaningful market deconcentration and broadened procurement access.

**4.3.2 Joint Venture vs Single-Bidder Analysis**

Table 13. Joint Venture and Single-Bidder Contract Analysis

Metric	Before Amendment	After Amendment
Number of JV Contracts	36	29
% of JV Contracts	80%	46%
Avg. JV Contract Amount (NPR)	286.2M	139.3M
Avg. Single Contractor Amount (NPR)	165.2M	59.96M
Single-Bidder Contracts (Overall)	8.89%	22.22%
Single-Bidder Contracts (Small 1S1E)	0%	0%
Single-Bidder Contracts (Large 1S2E)	8.89%	29.80%

The proportion of JV contracts decreased from 80% to 46%, potentially because technically capable firms now prefer to bid independently, or because the per-project restriction limits the strategic value of JV formations for workload expansion. Single-bidder contracts increased from 8.89% to 29.8% for large 1S2E projects, a concerning development indicating that reduced competition is leaving some high-value contracts without competitive alternatives. For small 1S1E projects, no single-bidder contracts were observed in either period, confirming that this segment remains robustly competitive. This divergence suggests that additional measures such as simplified prequalification for targeted contractor categories or revised qualification thresholds, may be needed specifically for large contracts.

**5. Conclusions and Recommendations**

**5.1 Conclusions**

This study provides rigorous empirical evidence that the 11th and 12th amendments to Nepal's PPR, 2064 — limiting contractors to a maximum of five concurrent projects — have produced a statistically significant and largely positive transformation in the procurement landscape for water supply projects within Koshi Province. The key conclusions are as follows.

Regarding bidding competition and price trends: The amendment has successfully curtailed the culture of aggressive low bidding. Average bid discounts fell by more than half from 28.66% to 11.80%, and the proportion of extremely low bids ( $\geq 20\%$  below estimate) for large projects plummeted from 84.4% to 10.6%. While competition was reduced (38.1% fewer bidders), the resulting bids are more realistic, economically sustainable, and closely aligned with engineer's estimates. However, the sharp rise in very high bids (4.4% to 25.5% for large projects) warrants vigilant monitoring for potential collusive behavior. The yearly trends confirm a clear structural break at the amendment date, supporting a causal interpretation.

Regarding project timely performance: The amendment has produced a remarkable improvement in project delivery. Mean delay fell by 90.1% from 488 to 48 days with 95% confidence intervals (CI). The proportion of projects requiring Extension of Time collapsed from 86.7% to 9.5%. The confirmed positive correlation ( $r = 0.38$ ,  $p = 0.004$ ) between bid discount and delay days validates the 'winner's curse' hypothesis. Kaplan-Meier survival analysis confirmed that large multi-year projects are now completed a median of 941 days sooner, delivering water supply infrastructure to communities significantly faster.

Regarding contractor market concentration: The market moved from moderately concentrated (HHI = 1,850) to unconcentrated (HHI = 1,240), with more contractors participating and dominant firms' market shares declining. The number of unique active contractors increased from 34 to 55. The deconcentration represents a key policy achievement. However, the rise in single-bidder large contracts (8.9% to 29.8%) indicates a persistent challenge requiring complementary policy measures to enhance competition in high-value procurement.

## **5.2 Recommendations**

Based on the study findings, the following recommendations are proposed:

- (i) Retain and enforce the five-project limit: The evidence supports retaining the current policy. PPMO should enforce it strictly through real-time monitoring via the [bolpatra.gov.np](http://bolpatra.gov.np) e-bidding portal, verifying contractor workloads before bid evaluation stages.
- (ii) Establish bid clustering surveillance: The sharp increase in very high bids warrants a formal bid screening protocol at PPMO to detect suspicious bid clustering patterns, particularly for large IS2E contracts. Bid rigging detection algorithms (Feng & Guo, 2025) should be explored.
- (iii) Address single-bidder contracts: Simplified prequalification pathways and targeted capacity-building programs for local contractors in remote areas of Koshi Province should be implemented to attract more qualified bidders to large water supply contracts.
- (iv) Introduce size-weighted project counting: The current flat limit of five projects does not differentiate between small and large contracts. A size-weighted or capacity-based limit would more accurately reflect contractor resource constraints.
- (v) Expand to other provinces and sectors: This study is limited to Koshi Province. Extension to other DWSSM provinces and other infrastructure sectors (road, irrigation, hydropower) would provide a comprehensive national assessment of the amendment's impact.

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