Journal of Economic Sciences
Volume 5, Issue 1
https://www.jesciences.com

Analyzing Construction Delays: A Cost Analysis of The Kohat-Karak N-55 Highway

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Timeline
Received: Nov 11, 2025
Revised: Jan 15, 2026
Accepted: Apr 24, 2026
Published: May 08, 2026

DOI
https://doi.org/10.55603/jes.v5i1.a5

Abstract
Infrastructure delays impose significant financial and road user costs, affecting economic, resource allocation, and project efficiency. This study examines the cost of inaction in project delay of the N-55 Indus Highway using a mixed-methods approach, incorporating both quantitative and qualitative data. The sludge method was applied to assess PC-1 revision costs, while the private cost method evaluated financial burdens on contractors and consultants. Findings reveal that delays account for 59.1% of the total project budget, with private costs contributing 13.87%, accounting costs making up 25.1%, and social costs comprising 20.13%. These delays lead to increased expenditures, rising labor costs, inefficiencies in resource utilization, and commuter inconveniences. Furthermore, prolonged inaction exacerbates financial instability, disrupts economic activities, and reduces public trust in infrastructure development. To address these challenges, this study recommends enhancing financial planning, ensuring timely fund disbursement, strengthening transparency, and improving interdepartmental coordination. Reducing political interference and adopting proactive management strategies can help mitigate future project inefficiencies and economic losses, ensuring sustainable infrastructure development.

Keywords: *Project Delays, Private Cost, Accounting Cost, Social Cost, Road Infrastructure*

JEL Classification: *L74, L92, O18, O20, O22*

1. Introduction
Improvement in human living standards is closely linked to the infrastructure development, particularly road networks that facilitate economic activity and communication. Infrastructure quality is a key component of the Global Competitiveness Index (GCI), reflecting a country's ability to provide a high standard of livings(Schwab, 2018).Despite the importance of infrastructure, construction delays remain a challenge in infrastructure projects and are widely recognized as a major cause of cost overruns, inefficiencies, and disputes in the construction industry. Delays occur when projects are not completed within the originally planned time due to financial, administrative, technical, and institutional factors (Flyvbjerg, 2004). In developing countries, where infrastructure development largely depends on public sector investment, the impacts of construction delays are more severe as they exert pressure on limited public resources and postpone the realization of expected socio-economic benefits (Bisbey, 2020).

In Pakistan, road infrastructure development is predominantly undertaken by the public sector through the National Highway Authority (NHA) and financed under the PSDP. Despite the critical role of road networks in economic growth and regional connectivity, many highway projects in Pakistan experience delays and cost escalations. These delays are commonly associated with weak project planning, inadequate feasibility studies, land acquisition issues, delayed fund releases, scope changes, and frequent revisions of Planning Commission 1 (PC-1) documents during project implementation. The prevalence of delays in Pakistan's road sector is closely associated with governance-related challenges (Safdar et al., 2022). Governance quality plays a critical role in the performance of the public infrastructure projects, particularly in the road sector where planning, financing, and implementation are managed by government

institutions. In Pakistan, weak governance and discretionary powers within public institutions have contributed to inefficient resource allocation, frequent project revisions, and delays in fund releases, which adversely affect the timely completion of road infrastructure projects (Haque, 2022).

Construction delays impose substantial costs on all project stakeholders. For the client agency, delays result in higher administrative and supervision costs, increased financial commitments, and delayed service delivery. Contractors and consultants face additional cost due to prolonged engagement of manpower, idle machinery, and extended overheads, often leading to claims and disputes (Islam, 2017).At the macro level, public infrastructure projects are central to Pakistan's economic growth and public welfare, with the PSDP serving as the government's primary instrument for achieving development objectives. However, the effectiveness of public investment has remained limited due to a sharp decline in development expenditure from 7.5 percent of GDP in 1992 to around 1 percent in recent year and the continuous addition of new projects, which has stretched PSDP resources thinly. As a result, a large share of projects experience delays and cost overruns, with 59 percent delayed and 16 percent facing cost escalation, while reliance on uncertain foreign assistance further strains domestic resources (Zubair, 2023).

The construction industry particularly road infrastructure serves as a critical driver of Pakistan's economic activity. It not only generates substantial employment but also supports broader economic performance (Khan, 2008). Large scale initiatives, such as the China–Pakistan Economic Corridor (CPEC), with an estimated investment of US$62 billion, were expected to catalyse economic transformation and accelerate growth in the construction sector (Ali, 2009). Despite these opportunities, the sector continues to experience persistent delays in project execution. An analysis of 65 projects by (Nadir, 2020) revealed that 97 percent faced delays and 90 percent encountered cost variations, with average cost overruns of 28.27 percent and average delays of 2.1 years. Road construction projects exhibited the highest delays, averaging 2.3 years. Such delays frequently result in cost overruns, disputes, and even project abandonment, ultimately undermining project feasibility and broader economic stability (Ali, 2009).

Infrastructure project delays and cost overruns remain a persistent global challenge. Recent studies in South Asia highlight contractor, material, and site related factors as major causes of road project delays (Andrić, 2024). In adjacent sectors, turkey industrial projects demonstrate similar patterns of cost escalation, yet detailed cost of inaction analyses remain limited (Álvarez-Pozo, 2024). Moreover, while micro-level work has begun to quantify road-user delay costs (Ahad, 2025), there remains a notable gap in combining private actor costs, accounting costs, and road-user (social) costs within one highway delay case study — especially in Pakistan's context. This study therefore contributes by being among the first to apply a comprehensive cost-of-inaction framework to the N-55 Indus Highway corridor, quantifying delay costs for all major stakeholders and drawing policy implications for improving public infrastructure delivery.Source: Author's Construction

The National Highway Authority (NHA) was established in 1991 to oversee the planning, construction, maintenance, and management of Pakistan's major highways and motorways. It was created to ensure better control of roads with national and strategic importance. Over the years, NHA introduced updated policies and operational codes to improve its technical, administrative, and financial management. Currently, NHA manages 12,131 km of roads, including national highways, motorways, and expressways. Although this network covers only 4.6% of Pakistan's total roads, it handles around 80% of commercial traffic, showing its key role in supporting trade and transportation across the country.

The National Highway Authority (NHA) head office is located in Islamabad and is led by a Chairman. It is organized into key wings such as Motorways, Highways, Finance, Administration, and Planning, each managed by a Member with support from General Managers who handle operations. NHA also operates through regional offices headed by Regional General Managers in all four provincial capitals,

as well as in Multan (Punjab South) and Abbottabad (Northern Areas). Each region includes a finance representative. Major projects are managed separately by Project General Managers, with dedicated finance officers to oversee accounts.

3. Methodology

The study uses a mixed methods methodology to analyze the costs linked with a construction project of N-55 Indus Highway, focusing on private, accounting, and road user costs. The data is collected from government records, project reports, and interviews with project stakeholders to obtain initial project cost estimates (PC-1), revised project costs (PC-1), and deviation from project's given timeline. Quantitative analysis is employed to address private and accounting costs, with secondary data collected from revised PC-1, extension of time, and contracts of the NHA with contractor and consultant. These documents provided numerical data on project budgets, contract values, labor costs, equipment cost, and other related expenses, which were thoroughly reviewed and analysed using simple cost analysis of per day, month, year and cost in delayed time (Andlib et al., 2022).

For road user costs, unstructured questionnaires were administered to commuters to gather qualitative data on additional expenses, time delays, and inconveniences. This qualitative data was then quantified using simple cost analysis of per day, month and cost in delayed time. Primary data for Road User Costs were collected directly from commuters through surveys and interviews, while secondary data for private and accounting costs were sourced from existing financial documents. This approach eased a comprehensive understanding of the project's financial and social impacts by leveraging both quantitative and qualitative data. The ultimate findings of the study sketch the significant cost of inaction on the project, revealing that delays or failures proceed with the construction could result in substantial financial and Road User Costs for all stakeholders involved. Additionally, analysis of the PSDP was conducted. This included estimating the cost of inaction in terms of PSDP allocation, calculating the cost of Inaction of NHA's allocation in the PSDP, the cost of inaction of infrastructure allocation in the PSDP, and the cost of inaction of in GDP from 2010-2024. These analyses highlighted the broader economic consequences of project delays, emphasizing the need for timely and efficient project execution.

3.1. Cost Estimation Formulas and Assumptions

To enhance transparency and reproducibility, the following formulas and assumptions were applied in calculating private, accounting, and Road User Costs.

1 Private cost of NHA

$$\text{PC} - 1 \text{ Revision Cost} = \sum_{i=0}^{n} Daily\ Salary\ of\ official_i \times \text{Number of Days Spent}_i$$

- $i = each\ official\ involved\ in\ PC-1 revision\ process$
- *n= total number of officials*
- *Daily Salary of Official = monthly salary*
- *Number of Days Spent = Working days spent on PC-1 revision*

2 Private Cost of Consultant

$$\text{Private Cost of Conultants} = \sum_{i=1}^{n} Daily\ Salary_i \times \text{Number of Days Worked}_i$$

- *i = each consultant (key or non-key personnel)*
- *n= total number of consultant personnel involved*
- *Daily Salary$_i$=Monthly Salary$_i$ ÷ 30*

- *Number of Days Worked$_i$ = total days spent on project activities (design review or supervision, including delays)*

3 Private Cost of Contractor

- **Office & Accommodation Rent**

Cost = (Monthly Office rent + Monthly Accommodation Rent) × Duration Delay (months)

- **Office Furnishing & Equipping**

$$\text{Cost} = \sum_{i=1}^{n} Unit\ Cost_i \times \text{Quantity}_i$$

N = total number (chairs, tables, cupboards, PCs, etc.)

- **Office Running and Maintenance**

Cost = (Monthly Utility Bills + Monthly Miscellaneous Expenses × Duration Delay (months)

- **Office Supporting Staff**

$$\text{Cost} = \sum_{i=1}^{n} Unit\ Cost_i \times \text{Quantity}_i$$

N = number of staff members

- **Transport Maintenance**

Cost= Monthly Transport Maintenance × Duration Delay (months)

- **Machinery & Equipment**

$$\text{Cost} = \sum_{i=1}^{n} Hourly\ Rate_i \times \text{hours Used}_i$$

N = total number of machines equipment's

4 Road User Cost and Assumptions

- **Time Cost**

The road user time cost was estimated by taking the average salary of a government employee at BPS-9 as a representative benchmark. Based on this, the additional travel time caused by construction delays was converted into monetary terms using daily, monthly, annual, and delayed-period calculations. This method allowed for quantifying the financial burden on commuters by generalizing the cost per individual to the total number of passengers and vehicle affected.

- **Fuel Consumption**

The fuel consumption cost overrun for road users was calculated by comparing the distance and fuel usage of coaches before and after the start of construction work. Due to diversions, vehicles traveled an additional 8 km per trip, leading to higher fuel requirements and costs. Using the average fuel price and consumption rate, the daily, monthly, and annual fuel cost overruns were estimated for a single coach and then aggregated over the four-year delay period. Finally, this cost was scaled up to the total number of coaches operating on the route, reflecting the significant financial burden of delays on commuters and transport operators.

- **Tire Cost**

The cost overrun due to extra wear and tear of tyres was estimated by assessing the additional distance covered after the start of construction. Diversions increased daily running from 134 km to 150 km, reducing tyre life and raising replacement frequency. Based on the average tyre price and lifespan, the daily, monthly, and annual tyre cost overruns were calculated for a single coach, and then extended to the four-year delay period. Finally, this figure was scaled to the total number of 1202 coaches operating on the route, showing a substantial increase in operational costs for road users.

- **Engine Cost**

The cost overrun due to additional engine oil consumption was calculated by comparing daily vehicle running distances before and after the start of construction. Diversions increased the daily travel from 134 km to 150 km, leading to higher engine oil usage. Using the average oil consumption rate and price, the daily, monthly, and annual additional costs were estimated for a single coach and then projected over the four-year delay period. This was further scaled to 1202 coaches operating on the route, showing a considerable rise in operational expenses for road users.

3.2. Sample Size

The sample size consisted of 40 Hiace/coaches' transporters, commuters / drivers / road users was determined at the saturation point, where responses became repetitive and no new insights emerged. In qualitative and mixed-methods research, saturation is recognized as a valid benchmark for determining adequacy (Guest, 2006). The data collected from this sample was subsequently extrapolated to reflect the broader population of affected road users.

3.3. Sampling Technique

The survey employed a purposive sampling technique to select 40 Hiace transporters as participants. These individuals were approached at three key transit points—Karapa Toll Plaza, Kohat Bypass, and Jail Chowk Karak—to complete questionnaires focused on travel time cost, vehicle operating cost, and accident-related expenses. The sample size was determined based on the saturation point, where additional responses yielded no new information, ensuring that data collected captured the main patterns and variations among commuters. Although the sample size was limited, it provided sufficient qualitative insights for estimating the broader impacts on road users within the study area, while maintaining methodological rigor through random selection and coverage of multiple representative locations.

4. Results and Discussion

The detailed breakdown of project records and reports related to the N-55 Indus Highway construction project were enhanced by insights from interviews with key stakeholders, offers a comprehensive understanding of the project's progress, challenges, and impacts, including the outcomes of PSDP analysis in terms of costs as a percentage of NHA allocation in PSDP, infrastructure projects allocation in PSDP, and overall PSDP in GDP. The analysis covers the correlation between infrastructure and GDP and various costs associated with the project. It details the private costs incurred by the NHA, consultants, and contractors, alongside the accounting costs, presenting a thorough financial overview. Additionally, the chapter explores the Road User Costs borne by commuters, such as time costs and vehicle operating costs, to provide a holistic understanding of the project's impact on all stakeholders. The results are reported below.

4.1. Project Records

PC-1 of the project was approved under PSDP 2017-2018 by the Executive Committee of National Economic Council (ECNEC) at an estimated cost of 30,130 million rupees. The Authorization of dualization of Indus Highway N-55 (Sarai Gambila to Kohat) section was issued by Planning Commission dated April 4, 2017 whereas the Administrative Approval was issued by Ministry of Communication (MOC) for the project on 03-05-2017. Thus, Indus Highway N-55 Sarai Gambila to Kohat project has been under execution in two packages since 2017.

- Package 1 Sarai Gambila to Karak
- Package 2 Karak to Kohat

Out of 30,130 million rupees, 14,268 million rupees were allocated to package 2, the case study in hand. The total length of the project is 128 km of which package 2 is of 68 km. In the initial phase, the NHA invited bids for the construction of the road, opening the bidding process on Nov 28, 2017. Following a rigorous evaluation, NHA selected M/s Anhui Engineering Group (ACEG) and Matracon Joint Venture (JV) construction companies on April 09, 2018. The contract was awarded at the evaluated price of rupees 11,945.66 million. At the same time, NHA initiated the consultancy procurement process, with the technical bid opening on Jan 23, 2018 and financial bid on May 10, 2018, as these steps are considered crucial for ensuring a comprehensive assessment of consultancy proposals. Subsequently, on Jan 16, 2019, NHA formally signed the consultancy contract with M/s Zeeruk International in a Joint Venture with M/s Kasib Associates. The consultancy contract was awarded at the cost of rupees 99.19 million. Commencement date for the project execution was set as May 26, 2018. With a stipulated timeframe of 730 days, Matracon embarked on the construction endeavor with diligence and dedication. The completion date was targeted for May 25, 2020, marking a significant milestone for the project's timelines (EOT).

After the project's commencement, the Contractors faced unexpected challenges, prompting them to formally request an extension of time (EOT). Recognizing the contractor's difficulties, the NHA granted an extension from May 2019 to December 2022, accommodating the inclusion of the new Spina Mor project. This adjustment necessitated a revision of the Planning Commission (PC 1) in September 2021 to incorporate design modifications and accommodate the expanded project scope. Despite the extension, delays are still there, causing the project's completion to surpass the revised timeline.

Table 1: Cost wise summary of original PC-1

Bill Section	Description	Bill of Quantity	Spina Mor Cost	Total Revised Cost
1	Earth Work	1,990,876,453	2,132,816,845	4,123,693,298
2	Sub Base and Base	2,559,706,337	758,806,516	3,318,572,853
3	Surface Course and Pavement	1,153,203,322	218,273,636	1,371,476,958
4	Structure (Box and Culverts)	435,108,019	494,497,826	929,605,845
5	Structure (Box Bridges)	1,570,246,029	186,734,323	1,756,980,352
6	Structure (Soil Investigation for Bridges)	14,512,875	1,566,500	16,079,375
7	Structure (Retaining Wall, Breast Wall, and Toe Wall	1,244,089,832	1,387,640,492	2,631,730,324
8	Drainage, erosion and protection Works	439,452,373	-	439,452.373
9	Ancillary Works	678,360,569	179,371,960	857,732,529
10	Ancillary Works (toll Plaza)	30,000,000	-	30,000,000
11	General Items	99,324,200	-	99,324,200
	Total	**10,214,880,009**	**5,359,708,098**	**15,574,648,107**

Source: Contract Document of Project

4.2. Project Reports

The project reports show a series of challenges, leading the Contractors to request an extension of time, including delays incurred due to various factors. The consultant's recommendation on these incurred delays addressed issues such as the integration of the Spina Mor project, disruptions caused by the COVID-19 pandemic, complications with the forest department, and impediments related to the removal of infrastructure like railway bridges and electricity lines. Inclement weather further intensified the project's timeline. To address these setbacks effectively, the consultant proposed an extension of 18 months, suggesting a revised completion date of May 20, 2023, to adequately execute both new and leftover work while navigating these complexities.

4.3. Interview with Planning Commission Transport and Communication Official

During an interview with an official from the Transport and Communication (T&C) section of Planning Commission, it was revealed that the NHA rarely submits PC-5 documents, having done so for

only four or five projects. The PC-5 document, essential for evaluating project completion and assessing outcomes against initial objectives, is often overlooked, which hampers thorough post-project analysis and continuous improvement. The official did provide data on five specific projects where the PC-1 documents had been revised. These revisions reflect adjustments in scope, budget, and timelines, highlighting the evolving nature of these projects and the necessity for ongoing modifications throughout their implementation. This information is crucial for understanding the practical challenges and adaptive strategies in managing large-scale infrastructure projects under the NHA's purview.

Table 2: NHA Revised PC-1 Projects

S. No.	Name of Project	Original PC-1		Revised PC-1	
		Approval Year	Project Budget in Million Rs	Approval Year	Project Budget in Million Rs
1	Makran Coastal Road Project (Which was revised to Makran Coastal Highway Project	2013	17,363.327	2022	21,400
2	Construction of Bridge Across River Chenab Linking Shorkot And Garh Maharaja	2009	1779.181	2015	4,048.264
3	Karachi-Multan-Lahore Motorway Project – Construction of Sukkur – Multan Section (387 Km)	2014	276,347.09	2016	314,977.28
4	China-Pak Economic Corridor Islamabad-Raikot Section (Phase-I) Havelian-Thakot	2014	86,880.08	2015	141,880.82
5	Construction of Black Top Road Between Sangan and Aab-e-Gum (length 42.00 km)	2014	1426.80	2017	2195.9

Source: Planning Commission

4.4 Interview with District Police Officer (DPO) and Emergency Officer (EO) of Kohat and Karak

Interviews were conducted at the District Police Officer (DPO) offices and Emergency Officer at Rescue 11 22 Kohat and Karak. They explained the concerning frequency of accidents on N-55 Kohat to Karak highway. The officials concluded that poor safety measures, road diversions and delay in project completion are the main factors contributing to these incidents. Data regarding road accidents from 2020 to 2023 brought forth the urgency of addressing safety concerns and expediting ongoing projects to mitigate risks on this critical roadway. The data provides quantitative evidence of the persistent challenges faced on this vital transportation route. In the year 2020, there were thirty-five cases of road accidents on N 55 Karak to Kohat highway, which caused forty-five deaths and one hundred and eighteen injuries. In the year 2021, the number of road accidents rose to fifty-two with seventy-five deaths and one hundred and eighty injuries. The figures of road accidents further raised to fifty-four in the year 2022 but a decrease was observed in the number of deaths and injuries as recorded deaths were fifty-eight and number of injuries decreased to one hundred only. For the year 2023, an increase was recorded in road accidents with sixty cases, and the number of deaths and injuries remained fifty-four and one hundred and twenty respectively.

Table 3: Accidents, Fatalities and Injuries from 2020 to 2023

Year	Accidents	Fatalities	Injuries
2020	35	45	118
2021	52	75	180
2022	54	58	100
2023	60	54	120

Source Rescue 1122 Kohat and Karak

4.5. Road User Survey

The objective of the surveys was to examine the influence of road user costs on road users. Unbiased responses were sought through surveys conducted at various locations along the study section, including Kohat Bypass, Kharapa Toll Plaza, and Karak Jail Chowk. Questions, both open and closed-ended, were asked regarding pre and post-construction travel time, fuel consumption, vehicle maintenance, and accident repair costs.

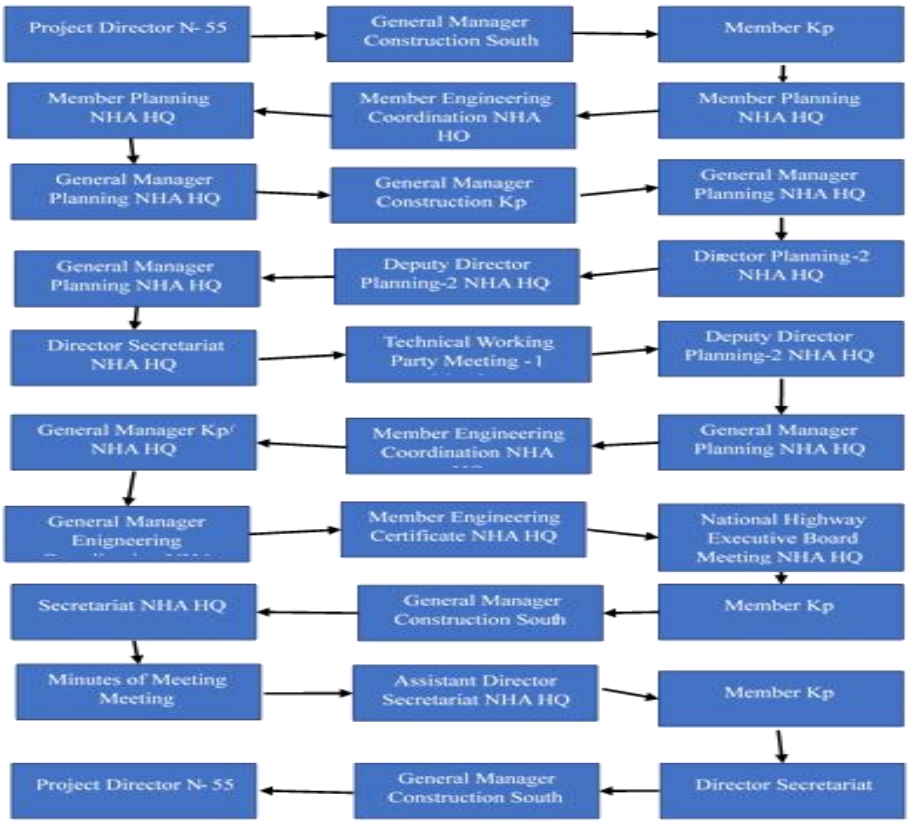
4.6. Revised PC-1

PC-I stands for Planning Commission Form -I, which is a project document describing project need, its description, justification, location, duration, cost estimates, and the tangible/non-tangible benefits associated with it (Ministry of Planning). The PC-1, or Planning Commission-1, is a key document for Pakistan's NHA. It's like a detailed plan for highway projects, showing what needs to be done, how much it'll cost, and why it's important. The NHA's Planning Wing creates this plan, making sure it follows rules and fits with the country's goals. The PC-1 is like a roadmap for decision-makers, helping them understand everything about the project, from engineering details to how it might affect people and the environment. So, it's a vital tool that guides the NHA in building and improving Pakistan's highways.

4.7. Process of Revised PC-1

For the N-55 Indus Highway project, design changes were done in the original plan because of which the PC-1 was revised. The Project Director started this process. It took three months for different NHA officials to carefully check and agree on the changes. Finally, the new plan got approved by the National Highway Executive Board (NHEB). After all this, the Project Director got the revised plan.

Figure 1: Process of Revised PC-1



4.8. Private Cost

4.8.1. Cost of NHA Official Salaries in Revising PC-1

In the process of revising PC 1, a total of 28 NHA officials participated, indicating a substantial level of involvement from the organization. The revision process itself spanned a duration of 3 months, underscoring the significant time and effort dedicated to refining the project plan. An interesting aspect appeared regarding the salaries of officials, revealing that the revision work accounted for approximately four out of eight working hours, totaling rupees 89,930. This suggests a considerable allocation of financial resources toward the revision work. Moreover, the process was initiated by the project director on September 7, 2021, and subsequently approved by the PC on November 4, 2021. It concluded with the final version of the revised PC 1 being received by the project director on December 7, 2021, signifying the completion of the revision process. The results show that a lot of work, time, and money went into revising PC 1 at the NHA.

Table 4: Average Cost of Salaries of NHA in Revised PC-1

Average Cost of Salaries	Rs 89,930

4.8.2. Cost of Printing, Electricity and Stationery on Revision of PC-1

The revision of the PC 1 document involved making five photocopies, which cost 2,125 rupees. Additionally, each individual involved in the revision process was provided with two pens, one pencil, and a highlighter, incurring a cost of 2,525 rupees. Moreover, electricity consumption related to photocopying the revised PC 1 document amounted to 500 rupees. These expenses highlighted the logistical and material resources necessary for the revision process, encompassing document duplication, stationery provisions, and utility usage.

Table 5: Cost of Printing, Electricity and Stationery on Revision of PC-1

Cost of Printing, Electricity and Stationery on Revision of PC-1	Rs 5,145

4.8.3 Cost of Salaries of Technical Working Party Meeting Participants

The Technical Working Party (TWP) plays a fundamental role in the approval process for project documents and proposals, including PC-I and PC-II forms, and the acceptance of necessity. Chaired by the Chairman of the NHA, the TWP comprises key members including the Member Finance and Member Operation/Construction of NHA, as well as officials from the Ministry of Planning and Ministry of Communication. Additionally, representatives from the National Transport Research Center (NTRC) and General Managers from various NHA departments are integral members. During TWP meetings, thorough evaluations are conducted to assess the feasibility and merits of proposed projects. Notably, the cost incurred for TWP meetings amounts to 10,820 rupees per day, calculated on the basic pay scale salaries of the participating members. This finding shows how much money is used for TWP meetings to make decisions

Table 6: Cost of Salaries of Technical Working Party Meeting Participants

Cost of Salaries of Technical Working Party Meeting Participants in Rs	10,820

4.8.4 Cost of Stationery and Refreshment of Technical Working Party Meeting

The total cost of stationery for Technical Working Party (TWP) meetings amounted to 4,433 rupees, covering essential items such as folders for meeting members, copies of meeting agenda documents, blank paper, pens, and pencils. Additionally, the cost of refreshments during TWP-1 tea breaks totaled

10,430 rupees, comprising expenses for mineral water (500ml), tissue boxes, cups of tea, samosas, biscuits, and pakoras. These findings show how money was spent on stationery and refreshments for TWP meetings, emphasizing the importance of catering to participants to ensure productive discussions.

Table 7: Cost of Stationery and Refreshment of Technical Working Party Meeting

Cost of Stationery and Refreshment of Technical Working Party Meeting in Rs	14,873

4.8.5 Cost of Salaries of NHEB Meeting Participants

The cost of organizing NHEB meetings, totalling rupees 11, 616 , was calculated on the basic pay scale salaries of the attending members. Chaired by the Chairman of the NHA, the NHEB comprised key officials including the Inspector General of National Highways & Motorways Police (NH & MP), Additional Secretary (Finance), Member or Additional Secretary (Planning & Development Division), Joint Secretaries from the Ministry of Communication (MOC), Senior Chief or Chief from the National Transport Research Center (NTRC), and representatives from organizations like NESPAK.

Table 8: Cost of Salaries of NHEB Meeting Participants

Cost of Salaries of NHEB Meeting Participants in Rs	11,616

4.8.6 Cost of Stationery and Refreshment NHEB of Meeting

The cost of stationery for NHEB meetings amounted to 4,433 rupees, covering essentials like folders, copies of working paper documents, blank paper, pens, and pencils. Additionally, the cost of refreshments during NHEB meetings totalled 21,885 five rupees, including expenses for mineral water (500ml), tissue boxes, nestle juice, sandwiches, kababs, cups of tea and green tea, coffee, samosas, biscuits.

Table 9: Cost of Stationery and Refreshment NHEB of Meeting

Cost of Stationery and Refreshment NHEB of Meeting in Rs	26,315

4.8.7 Total Private Cost of NHA in PC-1 Revision

The officials involved in the process of revising PC-1 expended 89,930 rupees, while stationery costs amounted to 5,145 rupees. Additionally, the TWP-1 meeting involved expenditures of 10,820 rupees for member salaries, 4,430 rupees for stationery, and 10,430 rupees for tea breaks. Similarly, the NHEB meeting incurred costs of 11,616 rupees for member salaries, 4,433 rupees for stationery, and 21,885 rupees for refreshments. Altogether, the total cost of the revised PC-1 process, including all associated meetings, sums up to 158,702 rupees.

Table 10: Total Cost of PC-1 Revision

Total Cost of PC-1 Revision in Rs	158,702

4.9 Private Cost of Consultant

4.9.1 Cost of Consultant Key Personnel (Design Review) Revised PC-1 Salaries

The private cost incurred for Consultant Key Personnel (Design Review) salaries in the Revised PC-1 amounted to rupees 239,172. This expense was accrued over a period of 31 days, during which 6 consultant officials were involved in the design review. These key personnel played an important role in conducting design reviews, ensuring the accuracy and effectiveness of the design in revised PC-1.

Table 11: Cost of Consultant Key Personnel (Design Review) Revised PC-1 Salaries

Cost of Consultant Key Personnel (Design Review) Revised PC-1 Salaries in Rs	239,172

3.9.2 Cost of Consultant Salaries in Delayed Time Key Personnel (Construction Supervision)

The accounting cost associated with Consultant Salaries in Delayed Time for Key Personnel (Construction Supervision) amounted to rupees 56.98 million. This significant expenditure encompassed the salaries of 10 key personnel employed by the consultant during the delayed period. These personnel played pivotal roles in overseeing and supervising the construction activities, ensuring adherence to quality standards and project timelines.

Table 12: Cost of Consultant Salaries in Delayed Time Key Personnel (Construction Supervision)

Cost of Consultant Salaries in Delayed Time Key Personnel (Construction Supervision) in Rs in million	56.98

4.9.3 Cost of Consultant Salaries in Delayed Time Non-Key Personnel (Construction Supervision)

The accounting cost associated with Consultant Salaries in Delayed Time for Non-Key Personnel (Construction Supervision) totaled rupees 105.83 million. This expenditure covered the salaries of 48 non-key personnel employed by the consultant during the delayed period. While not occupying key roles, these personnel contributed significantly to the construction supervision process, supporting key personnel and ensuring smooth project operations. Their collective efforts were essential in maintaining workflow efficiency and addressing project requirements.

Table 13: Cost of Consultant Salaries in Delayed Time Non-Key Personnel (Construction Supervision)

Cost of Consultant Salaries in Delayed Time Non-Key Personnel (Construction Supervision) in Rs in million	105.83

4.10 Private Cost of the Contractor

4.10.1 Office and Accommodation Rent

The monthly cost of office rent amounted to 80,000 rupees and cost of accommodation rent amounted to 40,000 rupees. Thus, the annual office rent comes to rupees 0.96 million rupees, and the annual rent of accommodation comes to rupees .48 million. However, during the delayed period of 4 years, the combined cost of running the office and accommodation surged to rupees 5.76 million. This finding highlights significant financial burden borne by the contractor due to the prolonged delay.

Table 14: Cost of Office and Accommodation Rent

Cost of Office and Accommodation Rent in Rs in million	5.76

4.10.2 Office Furnishing and Equipping

The contractor bears the cost of furnishing and equipping the project office, including chair, table, cupboard, PC, photocopier, printer, sofa set, and dispenser. The project office comprises of eight rooms and almost each room is equipped with the mentioned items. Per room cost of chairs comes to rupees forty thousand, table rupees 25,000, cupboard rupees 50,000, PC rupees 0.1 million, photocopier – rupees 0.5 million, printer rupees 0.15 million, sofa set rupees 45,000, and dispenser rupees 75,000. The combined cost of office furnishing and equipping amounts to rupees 3.88 million.

Table 15: Office Furnishing and Equipping

Office Furnishing and Equipping in Rs in million	3.88

4.10.3 Office Running and Maintenance

The office running and maintenance expenses comprise utility bills and miscellaneous costs. On a monthly basis, utility bills amount to rupees 8,000, covering electricity, water, and other essential services. Similarly, miscellaneous expenses, such as office supplies and repairs, come to rupees 8,000 per month. However, due to the ongoing delay and estimated completion of the project by December 2026, the contractor is compelled to spend an extra amount of rupees 7.68 million under this head.

Table 16: Office Running and Maintenance

Office Running and Maintenance in Rs in million	7.68

4.10.4 Office Supporting Staff

The office has a supporting staff consisting of two Naib Qasids, three cooks/helper, two sweepers, and two guards, each receiving a monthly salary of 40,000 rupees. These staff members are crucial for maintaining the office functioning. The estimated delay of 4.8 years in the project completion will compel the contractor to spend an extra amount of rupees 19.2 million on the salaries of office supporting staff.

Table 17: Office Supporting Staff

Office Supporting Staff in Rs in million	19.2

4.10.5 The Engineer's/Employer's Transport Maintenance

The maintenance of the Engineer's or Employer's transport costs 0.18 million rupees on monthly basis. This expense covers the maintenance and repair of vehicles essential for project operations. For the estimated duration of delay period, the maintenance cost will significantly increase up to rupees 5.18 million.

Table 18: The Engineer's/Employer's Transport Maintenance

The Engineer's/Employer's Transport Maintenance in Rs in million	5.18

4.10.6 Cost of Machinery

Three hundred and sixty-two machines and equipment are being utilized in the project. All these machines and equipment are hired at particular hourly rates, covering both rental and fuel expenses. The combined rental cost of all three hundred and sixty-two machines and equipment for the estimated delay of forty months will be 1,956.6 million rupees.

Table 19: Cost of Machinery

Cost of Machinery in Rs in million	1,956.6

4.10.7 Findings from Total Private Cost

The findings reveal considerable inefficiencies and financial impacts in the NHA handling of the PC-1 revision cost rupees 0.158 million rupees . The revision process spanned three months and involved thirty officials, reflecting significant time and resource consumption. Consultant costs were notably high, with rupees 0.239 million allocated for design reviews and rupees 56.98 million and rupees 105.83 million for key and non-key personnel during delays, respectively, reducing the consultant's profit margins. Additionally, the contractor faced substantial fixed costs including rupees 5.76 million for office and accommodation rent, rupees 3.88 million for office furnishing and equipping, rupees 7.68 million for running and maintenance, rupees 19.2 million for supporting staff, rupees 5.18 million for transport

maintenance, and rupees 1,956.6 million for machinery. These unavoidable expenses, totalling rupees 2,990 million, are likely to be passed on to the NHA. As a result, the NHA faces a significant increase in its financial burden, reflecting the broader impacts of delays and inefficiencies in project management.

Table 20: Total Private Cost of NHA, Contractor and Consultant

Total Private Cost in Rs in million	2,161.2

4.11 Accounting Cost of Delay factors

4.11.1 Major Delay due to Spina Mor and other Minor Factors.

The allocated amount for the project was rupees 14,268.3 million which was increased to rupees 15,574.6 million in Revised PC1 for a delay and left-over work in completion of the project by 31 x months. As for now, the estimated completion date is December 2026 with 40 x months overall delay period which will cost rupees 2,612.6 million.

Table 21: Cost of Delay due to Spina Mor and other Minor Factors

Cost of Delay due to Spina Mor and other Minor Factors in Rs in million	2,612.6

4.11.2 Finding from Total Accounting Cost

The findings underscore the substantial financial burden on the NHA due to inefficiencies in planning and project management. The total accounting cost amounts to rupees 3,919 million, while the cost of delays attributed to Spina Mor and other minor factors is rupees 2,612.6 million. This indicates a significant escalation in expenses, largely resulting from the extended timelines and complex approval processes associated with adding new projects to an existing one. The extensive delays are exacerbated by the need for additional approvals, such as those from the Planning Commission, which further complicate the project lifecycle. These figures highlight the critical need for improved planning and efficiency in the original PC-1 to mitigate excessive financial strain and avoid protracted delays.

Table 22: Total Accounting Cost

Total Accounting Cost in Rs in million	3,919

4.12 Road User Cost

4.12.1 Time Cost

The study probes into the financial implications of travel time costs incurred by commuters during construction delays. Initially, the daily travel time cost for a commuter with a Bps 9 salary was determined to be Rs 47 per hour. Anticipating a 30-minute increase in travel time due to construction, the additional daily cost was calculated at Rs 23.5. Projecting this increase over a month produced a total of rupees 705, and over a year, rupees 8,460. Over a 4-year delay period, the collective cost overrun for one commuter amounted to rupees 33,840. Generalizing this to a Hiace accommodating 18 commuters, the total cost overrun reached rupees 609,120. As 1202 hiace affected by the delay, the travel time cost overrun rushed to a significant rupees 732.2 million. The study highlights the significant economic impact on commuters due to construction delays, highlighting the urgency of timely project completion to mitigate financial burdens.

Table 23: Time Cost

Bps	Salaries Per Month in Rs	8 Working Hours Salary Per day in Rs	30 min working hours In Rs	Monthly Increase	Annual Increase	Increase in Delay time	Commuters in 1 Hiace	Time Cost overrun of 1,202 Hiace in Rs Million
9	33,820	1,127.3	23.5	705	8,460	33,840	18	732.16

4.12.2 Fuel Consumption

The analysis focuses on the financial implications of fuel consumption costs for hiace during the construction period. With an average fuel price of Rs 239 per liter over the span of 2021 to 2024, the distance covered along the N55 route increased from 67 km to 75 km due to diversions prompted by construction work, resulting in an 8 km difference. Before construction begun, the one-way fuel consumption of a hiace was 22.33 liters, costing rupees 5337.66. Post-construction, the consumption increased to 25 liters, costing Rs. 5975, resulting in a difference of rupees 637.34. With a daily running distance of 150 km per hiace, the daily fuel cost overrun amounted to Rs. 1274.68, accumulating to rupees 38,240.4 monthly and rupees 4,58,884.8 annually. Over the delay period from 2021 to 2024, the fuel cost overrun for a single hiace totalled rupees 1.835 million, while for 1202 hiace, it surged to a significant Rs. 2,206.3 million.

Table 24: Fuel Cost

Hiace	Average petrol price in Rs	Actual distance	Increase in Distance	Average Fuel Consumption of Hiace	One-way Consumption before Construction	One-way Consumption after start of Consumption	One-way Consumption before Construction	One-way Consumption after start of Consumption
1	239	67	75	3Ltr/km	22.33	25ltr	5,336.87	5,975

Difference in cost of one-way fuel consumption before and after start of construction work	Average daily running of a coach on N 55 in case study area	Daily difference of cost of fuel consumption of a coach
637.34	150	1,274.68

Monthly difference of cost of fuel consumption of a coach	Annual difference of cost of fuel consumption of a coach	Cost of fuel consumption of a coach for the period of delay
38,240.4	4,58,884.8	18,35,539.2

Cost of fuel consumption of 1202 x coaches for the period of delay (2021 – 2024) in Rs million
2206.318

4.12.3 Tires Cost

The study examines the financial implications of tire consumption costs for hiace during the construction phase. With an average tire price of rupees 0.12 million spanning 2017 to 2024, the N55 route distance increased by 8 km from 67 km to 75 km due to construction diversions. Before construction, hiace covered 134 km daily, increasing to 150 km post-construction. Tire lifespan decreased from 7.4 to 6.6 months after construction commenced, resulting in a daily cost rise from rupees 536 to rupees 600. This decoded to a monthly overrun of rupees 1,920 and an annual overrun of rupees 23,040 per hiace. Over the delay period (2021-2024), the total tire overrun for 1202 hiace amounted to rupees 110.78 million, underscoring the significant financial strain imposed by increased tire consumption during construction delays.

Table 25: Tires Cost

Hiace	Average tires Price (2017 - 2024)	Actual distance	Increase in Distance	Completion of tyres life before start of construction work	Completion of tyres life after start of construction work	Difference in completion of tyres life before and after start of construction work	Per day cost of tyres before start of construction work	Per day cost of tyres after start of construction work
1	120,000	67	75	223.88 days	200 days	24 days	536	600

Difference in daily cost of tyres before and after start of construction work	Average daily running of a coach on N 55 in case study area
64	150

Monthly difference of cost of tyres of a coach/ monthly tyres cost overrun of a coach	Annual difference of cost of tyres consumption of a coach/ annual tyres cost overrun of a coach	Cost of tyres of a coach for the period of delay (2021 – 2024)
1,920	23,040	92,160

Cost of tyres of 1202 x coaches for the period of delay (2021 – 2024) in Rs million
110.77

4.12.4 Engine Oil Cost

The analysis investigates into the impact of engine oil consumption costs for hiace in the construction period. With an average consumption of 5.5 litres per 3000 km at a price of rupees 1700 per litre spanning 2017 to 2024, the cost per km amounted to rupees 3.1. Prior to construction, hiace covered 134 km daily, increasing to 150 km post-construction. The N55 route distance rose from 67 km to 75 km due to construction diversions, resulting in a daily cost increase from Rs. 417.63 to Rs. 468. This led to a daily cost difference of Rs. 50.37, translating to a monthly overrun of Rs. 1,511.1 and an annual overrun of rupees 18,133.2 per hiace. Over the delay period from 2021 to 2024, the engine oil overrun for a single coach totalled rupee 72,532.8, while for 1202 coaches, it reached a significant rupee 87.18 million.

Table 26: Engine Oil Cost

Hiace	Average engine oil Consumption of a coach:	Average Engine Oil Price (2017 - 2024)	Average Cost of engine oil Consumption of a coach	Average Cost of engine oil Consumption of a coach for one km	Average daily running of a before start of construction	Average daily running of a coach after start of construction	Daily Cost of engine oil (134 km) before start of construction	Daily Cost of engine oil (150 km) after start of construction
1	5.5 litres / 3000 km	Rs 1700 / litre	Rs. 9,350 / 3000 km	9,350/3000 = 3.1	134 km (A single trip)	150 km (A single trip)	417.63	468

Difference in daily cost of engine oil before and after start of construction work	Average daily running of a coach after start of construction work
50.37	150

Monthly difference of cost of engine oil before and after start of construction work of a coach/ monthly engine oil cost overrun of a coach	Annual difference of cost of engine oil before and after start of construction work of a coach/ annual engine oil cost overrun of a coach	Cost of engine oil consumption of a coach for the period of delay (2021 – 2024)
1,511.1	18,133.2	72,532.8

Cost of engine oil consumption of 1202 x coaches for the period of delay (2021 – 2024) in Rs million
87.18

4.12.5 Finding from total Road User Cost

The findings of the Road User Cost highlight the significant financial burden caused by construction delays, primarily affecting travel time, fuel consumption, tire wear, and engine oil usage for commuters using Hiace vehicles along the N55 route. Commuters faced increased travel time, leading to higher costs, while the construction diversions caused fuel consumption to rise, further inflating operational costs for each vehicle. The extended delay also accelerated tire wear and increased engine oil consumption due to the longer distances covered daily. These factors, combined over the 4-year delay period, resulted in substantial financial strain on commuters and vehicle operators, with the total cost overrun for 1202 Hiace vehicles reaching a staggering 3,136.4 million rupees. This underscores the need for better planning and efficiency to minimize the economic impact on road users during prolonged construction periods.

4.12.6 Accident Cost

The cost of accidents was assessed by collecting data from road users through questionnaires. According to the responses received, the repair costs varied significantly depending on the type of vehicle involved. For bike accidents, repair expenses ranged from rupees 30,000 to 35,000, while car accidents incurred costs between rupees 300,000 and 350,000 for repairs. Similarly, accidents involving hiace vehicles resulted in repair costs ranging from 800,000 to 1,000,000 units, whereas truck accidents incurred expenses varying from rupees 1 million to 1.5 million rupees. These findings underscored the substantial financial burden borne by individuals and businesses due to road accidents, highlighting the importance of preventive measures and enhanced safety regulations on the roads.

Table 27: Accident Cost

Vehicle Type	Minimum Repair Cost (Rs)	Maximum Repair Cost (Rs)
Bike	30,000	35,000
Car	300,000	350,000
Haice	800,000	1,000,000
Truck	1,000,000	1,500,000

4.12.7 Total Cost in Percentages

The project's cost is estimated at 15,574.6 million rupees, within which different cost components contribute varying shares. The private cost amounts to 2,161.5 million rupees, representing approximately 13.87% of the total. The accounting oat is higher at 3,918.9 million rupees, accounting for about 25.2%, while the social cost stands at 3,136.9 milllion rupees, contributing nearly 20.13% to the overall project cost.

Table 28: Cost in Percentages

	Costs in millions	Project cost (millions)	% of project cost
Private cost	2,161.5	15,574.6	13.87%
Accounting cost	3,918.9	15,574.6	25.1%
Social cost	3,136.4	15,574.6	20.13%

5. PSDP Analysis

The PSDP plays a key role in driving Pakistan's economic growth by funding major infrastructure and public service projects. This analysis examines the financial and economic consequences of delays and inaction in key sectors such as highways, power, water, railways, and communication. It highlights how such inefficiencies increase project costs, slow down development, and negatively affect GDP. The study underscores the importance of timely and efficient execution to support the country's overall economic progress.

5.1 Analysis of the Cost of Inaction on NHA Budget Allocation in PSDP

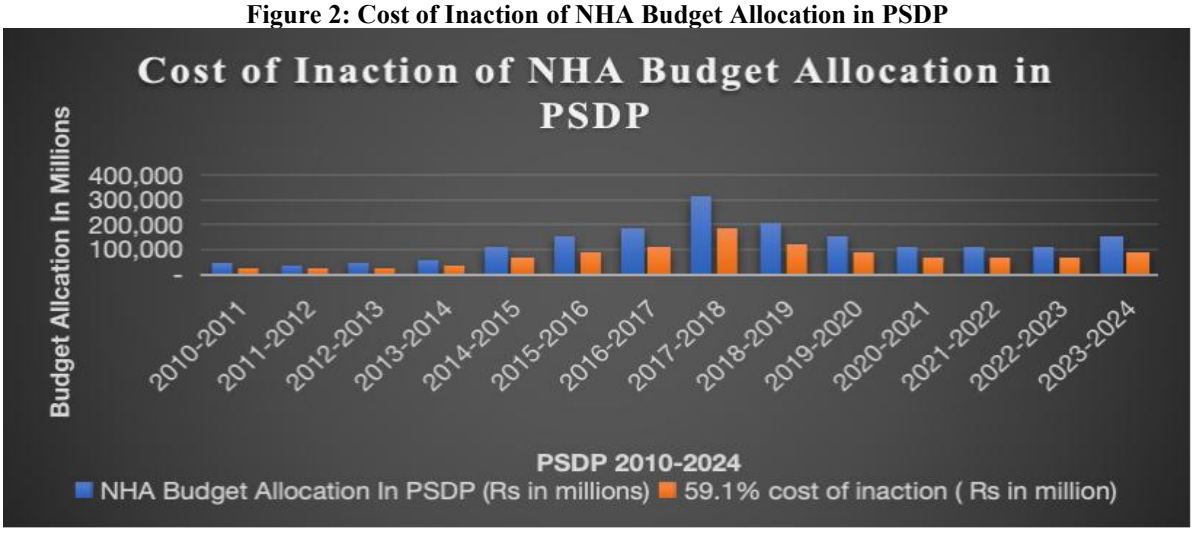
The analysis of the NHA under PSDP highlights the economic impact of project delays and inefficiencies. Estimating the cost of inaction at 59.1% of the annual allocation reveals substantial financial losses. The table shows that delays significantly drain public funds, making timely project completion essential to reduce costs and ensure effective use of resources over various fiscal years.

Table 29: Cost of Inaction of NHA in PSDP

Years	NHA Budget Allocation in PSDP (Rs in millions)	59.1% cost of inaction (Rs in million)
2010-2011	44,641	26,382
2011-2012	39,900	23,580
2012-2013	50,732	29,982
2013-2014	63,039	37,256
2014-2015	111,563	65,933
2015-2016	159,600	94,323
2016-2017	188,000	111,108
2017-2018	319,720	188,954
2018-2019	210,000	124,110
2019-2020	155,967	92,176
2020-2021	118,675	70,136
2021-2022	113,750	67,226
2022-2023	118,403	69,976
2023-2024	157,500	93,082

The chart shows major financial losses from inaction, estimated at 59.1% of the National Highway Authority (NHA) budget in the PSDP over different fiscal years.

Figure 2: Cost of Inaction of NHA Budget Allocation in PSDP



The figure 2 presents NHA budget allocations in the PSDP from 2010–2024. Blue bars show actual funding for road development, while orange bars indicate the estimated cost of inaction, reflecting potential economic losses. The gap highlights the opportunity cost of underinvestment, leading to delays, higher project costs, and reduced productivity. Ongoing funding shortfalls have prolonged project timelines, increased expenses due to inflation, and added pressure on limited budgets, ultimately slowing economic growth.

5.2 Analysis of the Cost of Inaction on Infrastructure Budget Allocation in PSDP

The analysis of inaction in PSDP infrastructure spending highlights the economic impact of high investment with low returns. The tables below show actual allocations for the power, water, railway, and communication sectors. Applying a 59.1% inaction rate to PSDP infrastructure allocations reveals major losses that delay project completion. The figure 3 below presents the estimated cost of inaction based on actual PSDP spending.

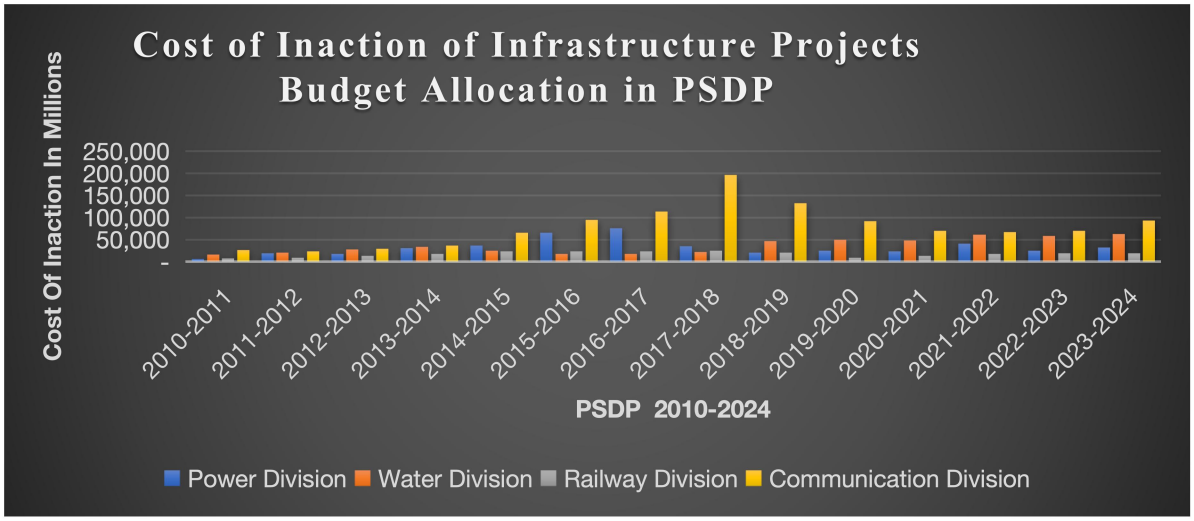
Table 30: Infrastructure Projects

Years	Power Division	Water Division	Railway Division	Communication Division
	Rs in Million			
2010-2011	12,030	28,424	13,630	44,786
2011-2012	32,500	36,136	15,000	40,072
2012-2013	29,650	47,192	22,877	50,874
2013-2014	51,443	57,840	30,965	63,148
2014-2015	63,613	43,427	39,566	111,754
2015-2016	112,288	30,120	41,000	159,965
2016-2017	130,000	31,716	41,000	193,285
2017-2018	60,909	36,750	42,900	333,380
2018-2019	36,125	79,000	34,411	224,481
2019-2020	41,792	85,021	16,000	156,215

2020-2021	39,650	81,250	24,000	118,930
2021-2022	69,485	103,473	30,026	114,201
2022-2023	43,133	99,572	32,648	118,583
2023-2024	54,550	107,500	33,000	157,860

Source: PSDP Planning Commission

Figure 3: Infrastructure Projects



The chart compares PSDP infrastructure allocations with the cost of inaction across the power, water, railway, and communication sectors. It shows that the power and especially the communication sectors face the highest potential losses, while water and railways also reflect notable impacts. The gap between allocation and inaction highlights weak prioritization, delays, and underinvestment, indicating the need for better resource planning.

5.3 Analysis of the Cost of Inaction in GDP

The analysis shows that inaction has a major negative impact on Pakistan's GDP, with losses estimated at 59.1% each fiscal year. It highlights how delays across sectors create a heavy economic burden, stressing the importance of completing development projects on time to support growth and reduce losses.

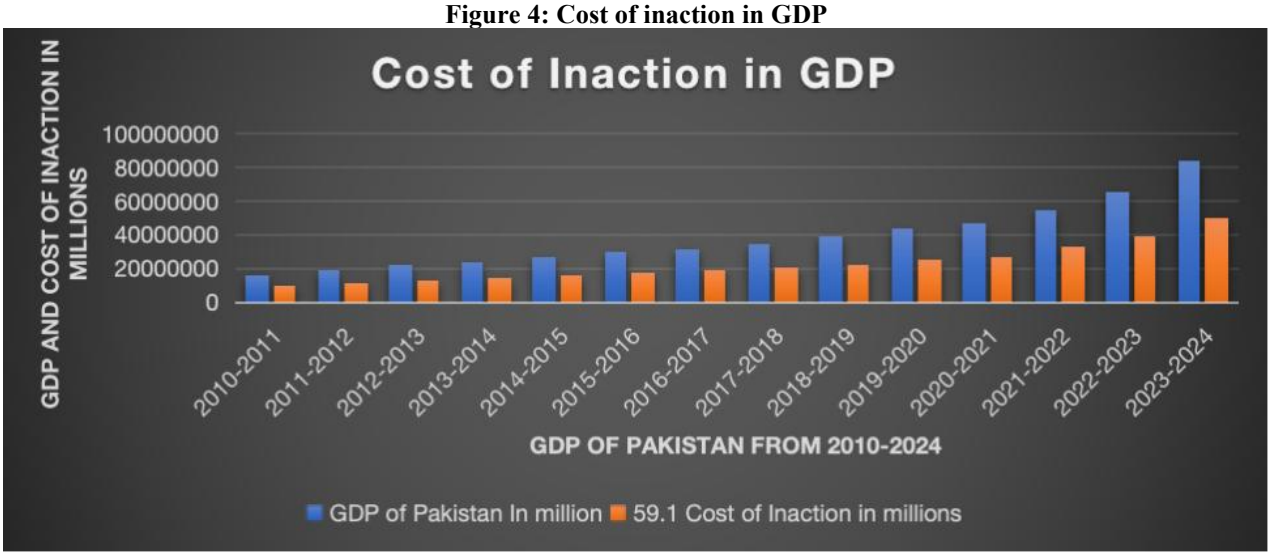
Table 31: Cost of Inaction in GDP

Years	GDP of Pakistan in million	Cost of Inaction in millions
2010-2011	16507053	9755668
2011-2012	19731030	11661039
2012-2013	22344639	13205682
2013-2014	25042169	14799922
2014-2015	27952815	16520114

2015-2016	30425879	17981694
2016-2017	32725049	19340504
2017-2018	35552819	21011716
2018-2019	39189810	23161178
2019-2020	43798401	25884855
2020-2021	47540409	28096382
2021-2022	55836225	32999209
2022-2023	66623563	39374526
2023-2024	84658000	50032878

Source: Author's Own Calculations

Figure 4: Cost of inaction in GDP



The figure highlights that about 59.1% of GDP reflects the cost of inaction. The blue bars represent Pakistan's GDP from 2010–2024, while the orange bars show the portion lost due to delays, inefficiency, or underuse of resources. This comparison shows that a large share of economic potential was not fully utilized. It emphasizes the need for timely decisions and effective policies to reduce losses and improve overall economic performance.

6. Conclusion and Policy Recommendations

The study was carried out to identify the cost of inaction in the Kohat to Karak section of the N-55 Indus Highway, revealing that delays led to an additional burden of 59.1% of the revised PC-1 cost. These results align with the detailed findings of the research, which showed substantial private costs for the NHA, Contractor, and consultant, significant accounting costs due to project delays, and major road user costs including travel time, fuel, tire, and engine oil expenses, as well as accident-related costs These inefficiencies resulted in significant private, accounting, and Road User Costs affecting NHA, consultants,

contractors, and thousands of commuters. The findings underscore how construction delays translate into broader economic disruptions, resource misallocation, and lost opportunities for development in vital sectors. To prevent such losses, it is essential to streamline planning, ensure timely PSDP funding, and minimize political interference. Projects with over 60% physical progress should be prioritized for completion to secure public benefit and avoid further cost overruns. In contrast, projects at or below 10% progress should be reconsidered or halted. Moreover, new projects should be restricted until financial discipline is restored. NHA's Cash Development Loan (CDL) policy should be reviewed and converted into a direct funding mechanism to ease fiscal pressure. A comprehensive performance evaluation of NHA's portfolio since its establishment is also necessary to identify systemic flaws and improve future project delivery.

To strengthen this policy effort, future research could adopt a zone-wise approach as NHA operates across different geographical zones to identify region-specific causes of delay and enable more targeted planning solutions. Additionally, comparative studies across multiple projects would help generalize insights and support evidence-based policy reforms at the national level.

Acknowledgments:
The authors express gratitude to the respected referees, reviewers, and editors for their valuable feedback. Moreover, all remaining errors are our own.

Data Availability Statement:
Data is self-collected from published (secondary) sources, and will be provided on demand.

Funding:
This research has received no external funding.

Conflict of Interest Disclosure Statement:
There is no conflict of interest among the authors of the study.

Ethical Approval:
This research article has not violated any ethical standards.

Author Contributions:
Sherbaz Khan: Conceptualization, Methodology, Data Curation, Software, Writing – original draft preparation, Writing – reviewing and editing.
Saba Anwar: Conceptualization, Software, Writing – reviewing and editing.

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