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The Dark Days: Nepal's Decade-long Load Shedding and Its Lessons

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Abstract

Nepal is believed to have the potential for 42,000 megawatts of hydropower, which is the second-highest per capita potential in the world. Nepal is also one of the first countries in Asia to install a hydropower plant (1911 AD) with a generation capacity of 500 KW. However, the growth of the hydropower sector in Nepal remained slow for a long period as demonstrated by the fact that in the past 112 years, Nepal's generation capacity increased from 500 KW to 2,900 MW. A more troubling fact about Nepal's hydropower is that for ten years (from 2006 to 2017 AD) the country endured a severe load shedding, which continued under the governments of several parties, various leaders, and different executive directors of Nepal Electricity Authority. And suddenly, it ended magically, almost overnight. This raises several questions. What factors were responsible for the load shedding and why it ended so suddenly? Was this manufactured by a nexus of policymakers, bureaucrats, commission agents, and business houses for personal gains? Or it was a result of policy failure or constraints such as lack of capital and geographical obstacles. This article sheds light on these issues. Further, the article explores whether a similar load shedding is possible in the future, and if possible, for what reasons, and what needs to be done to prevent it. To answer these questions the article collected primary data using key informant interviews and questionnaire surveys. The research found that the load shedding was a result of several factors including corruption and policy failure, and it had cost the country billions of dollars. The research also found that there is a possibility of another load shedding, which can be avoided through measures such as legal, financial, and public education.

Keywords: Load shedding, Management, Policy, Production.

Conflict of Interest: There is no conflict of interest and any financial assistance is not accepted for the research.

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1. Background

Nepal and its hydropower potential: A Himalayan republic, Nepal is relatively a small country in between two giants, China in the north and India in the South. 'Although Nepal spreads over a total area of about 147,181 sq km or 56,827 square miles' (Bradford, 2015), it is renowned for its diverse landscape that ranges from Himalayan mountains in the North, Mahabharat hills in the middle and Terai plains in the south. With several lakes and thousands of big and small rivers starting from the high Himalayas in the north and flowing to the lowlands of the south in a span of about 150 to 250 kilometers, just the sheer volume of water and the gravity make Nepal a country with the second highest potential for hydropower per capita in the world.

Of the total area of the country, about 7% is covered by water, which includes over 6000 rivers (USAID/Nepal. n.d.) and about 5,300 lakes (Baral, 2021). Although Nepal measures less than 250 kilometers from north to south, its elevation ranges from below 70 meters to above 8000 meters from the sea level. This is the greatest altitude change of any country in the world (Malla, et al. 2023).

However, several natural obstacles challenge the great potential of Nepal's hydropower. For example, the seasonal variation in the amount of water in these rivers, which is three times lower in winter compared to the summer rainy season, presents various costs, design, utilization, and policy issues. Most of these rivers flowing through the Himalayan seismic zone and landslide-prone young mountains increase the risks of damage to hydro projects from landslides, sedimentation, and floods. For these reasons, building large dams for hydropower, irrigation, and flood control has been hugely controversial resulting in underutilization of this potential.

The decade-long load shedding of Nepal: The Pharping hydropower project established in 1911 AD during the Rana regime, as the fourth earliest hydropower project in Asia, is a national pride, and so is the rapid growth in this sector after the advent of democratic rule in 1990. However, the decade-long load shedding that occurred under the direct watch of several governments of various democratic parties is a national shame. This infamous load shedding imposed on the public occurred from 2006 to 2017 AD, or 2063-2074 BS (Shrestha, 2011). It took an additional year to eliminate the load shedding imposed on the industrial sector. As such, the "dark days" had started two years before the country became a republic and lasted for another eight to nine years.

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Most Nepalese experts on hydropower attributed the inadequate supply of electricity to this load shedding. With rapid urbanization, the demand for electricity was increasing. Although supply was also increasing, it was not increasing adequately enough to meet the increasing demand. However, critics argue that the real reasons for this load shedding were poor planning and management. As justifications for this assertion, they point out the lack of a vision and a plan to produce electricity at par with the increasing demand. Long gaps between the construction of new projects and mistakes committed while making Power Purchase Agreement (PPA) agreements are considered as other reasons. Critics have also pointed out corruption by the then authorities of Nepal Electricity Authority (NEA) and Ministry of Energy, Water Resources, and Irrigation (MEWRI) as another possible cause.

A brief review of the developments in the hydropower sector during a period leading to the decade-long load shedding provides some evidence for this assertion. Norwegian Star Kraft Company had transferred the Khimti project, 60 megawatts (MW) to NEA after 20 years. However, perhaps because of poor PPA negotiations by the then authorities with this company, NEA had to pay a very high price of about Rs. 15 per unit. As per its PPA signed with the Bhote Koshi project built by the Panda Group of the USA and Solti Group of Nepal, the NEA was required to buy electricity from them in US dollars and pay about 12 cents per unit. Kali Gandaki started to supply 144 MW to the national grid in the year 1997 and proved a boon in the face of rapidly growing demand. Within a year, however, Kali Gandaki also, along with all other projects, failed to meet the growing demand. As such, too few projects, poor PPA negotiations, and delays also contributed to power crises in Nepal.

2. Problem Statement

From the experience of the two cases of load shedding of the past as well as the dismal performance in harnessing this most significant natural resource of the country, one can appreciate the fact that the problems being faced by Nepal's hydropower sector are wide-ranging and quite complex. Unless these problems are correctly identified and resolved, one cannot be assured that there will not be another, perhaps a more serious, load shedding in the future. In interviews, the NEA authorities have already warned of such a possibility if obstructions created by various vested interest groups, particularly in the expansion and upgrading of the transmission and distribution networks are not resolved in a timely fashion.

What can directly contribute to the prevention of another load shedding in the future is a study of the decade-long load shedding and derive lessons for the future. Such a study should address, among others, the issues such as what caused the load shedding, its impact on the national economy, and measures taken to end it.

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It is indisputable that a broader study of the sector in terms of its potential in the face of emerging global events such as climate change and carbon emission, new technologies in the areas of generations and storage, opportunities for export and effective domestic utilization, as well as obstacles and constraints, would certainly assist in charting vision and devising strategies to take advantage of this most important natural resource. Literature shows that such efforts are being made by various authors, researchers, and experts. However, what is particularly missing is a specific and in-depth study of the decade-long load shedding, which can offer various lessons to prevent such an occurrence in the future.

This paper, therefore, aims to contribute towards preventing the potential for future load shedding, and by doing that, provide support in the accelerated development of the sector. This will be done by exploring the true causes of the decade-long load shedding as well as the strategies employed to end the load shedding dramatically within a short period of time. The paper will also explore the strategies adopted by the public to cope with the decade-long load shedding and its cost to the nation, as well as whether new issues are emerging that may cause load shedding in the future .

3. Objectives:

The core objective of this paper is to draw lessons for the future by unraveling the various aspects of the decade-long load shedding, including its true causes, costs to the nation, and what led to its dramatic end. The specific objectives of the paper are to:

1. Study the extent of the decade-long load shedding and explore its key causes.
2. Assess the overall impact of this load-shedding on the consumers and the country in terms of financial and social costs.
3. Uncover the factors behind its dramatic end, and identify the lessons for the future, and

Explore if there is a possibility of a similar load shedding in the future. If yes, what does it take to prevent it?

4. Methodology:

Various methods and tools of an exploratory research design were employed to gather and analyze data needed to achieve the above objectives. Both primary and secondary sources were used to collect data and evidence. Secondary information came from official reports of NEA and the Department of Energy, official documents, and whitepapers of the MEWRI as well as journal and newspaper articles. The primary information was collected using both qualitative and quantitative methods. Qualitative information, particularly the non-numerical data was collected through key informant interviews (KII), and quantitative data was collected by administering a questionnaire. Respondents were reached physically as well as through emails.

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Qualitative information, particularly the non-numerical data was collected through key informant interviews (KII), and quantitative data was collected by administering a questionnaire. Respondents were reached physically as well as through emails. For sampling, the population of the study was clustered as (a) policymakers (relevant government officers, political leaders), (b) investors (bankers, entrepreneurs), (c) experts and opinion leaders, and (d) end-users or the customers of NEA and the public. While the information from the end users was solicited using quantitative tools, the qualitative interviews were conducted with other clusters. Territorially, the study was limited to Kathmandu Valley.

5. Literature Review: Literature review was conducted intensively to identify the extent and causes of the decade-long load shedding. Reviewed literature included journal and newspaper articles, publications of the Ministry of Energy, Water Resources and Irrigation, reports of the Nepal Electricity Authority as well as publications of various institutions working in the development of the hydropower sector in Nepal.

5.1. The extent and causes of the load shedding: It has been over six years since the decade-long load shedding ended, still, the memory of this national tragedy is fresh in the minds of most Nepalese. At the height of it, load shedding was imposed for over 16 hours a day all over the country (Shrestha, 2011), except in a few towns and villages that were receiving electricity from local projects and were not connected to the national grid. While domestic consumers suffered load shedding for a decade, most industries had to wait for another year (The Kathmandu Post, 2018) to receive 24 hours of supply. During the load shedding, although domestic customers received four to six hours of supply in a day, it was mostly during odd hours such as the middle of the night or in the early morning hours. This forced consumers to resort to storing power as much as they could in large batteries, electric lamps, and other storage devices (Vota. 2010). They also tried to use every electrical device during those hours such as to pump water, iron clothes, and run cook-stoves. This maximum use of power when available contributed to furthering load shedding. To supplement the limited supply, people also bought inverters, diesel generators, solar water heaters, and solar lighting systems (Sangraula. 2017).

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What were the key causes of this load shedding? Literature shows that the two obvious factors responsible for the decade-long load shedding that occurred between 2063 and 2073 BS, or 2006 to 2017 AD were *inadequate supply* and *accelerated demand*.

When the supply could not catch up with the demand, the load shedding occurred. Had there been enough supply, neither the customers would need to ration their consumption, nor those in power could extort bribes manipulating the limited supply. One of the then board members of NEA asserted that while there were rumors of corruption being the main cause of the load shedding, the real cause was a shortage in supply. Previous secretary of the Ministry of Energy, Water Resources and Irrigation, Kishor Thapa (Thapa, 2068), argued that the main cause of the load shedding was slow development of new projects for a long time (Thapa, 2068, p.11). Then the question arises, Why the development of new power generation projects could not catch up with the increasing demand? Why was the construction of new projects delayed despite knowing that demand was going to increase significantly? Why did the demand expand so dramatically, especially after the abolition of the monarchy? What the literature suggests on these subjects is summarized in the following table and discussed in detail below.

Table -1: Key Causes of the Decade-Long Load Shedding of Nepal

A. Limited supply (Why new generation projects could not catch up with the demand?)	1.1. Political instability and People's war .
	1.2. Lack of capital, technology, market, and foreign influence
	1.3. Corruption and creation of artificial supply shortage
	1.4. Obstructions and political interference
	1.5. Unclear vision, plans and policies and operational inefficiencies
B. Significant expansion in demand (Why did the demand expand so dramatically?)	2.1. Democratic government's commitment to universal coverage
	2.2. Raised expectations of people and their claim to access to electricity as their right
	2.3. Transmission expansion in new territories - towns and villages

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5.1. Why supply could not catch up with increasing demand: Experts and practitioners have pointed out various factors due to which the supply could not catch up with the increasing demand. They include, as listed in the table above: political instability and peoples' war; lack of capital, technology, market, and foreign influence; corruption and creation of artificial shortages; obstructions by various interest groups; and poor management and operations. Chitra KC summarizes these constraints as: "the persistent political instability, the resource constraint, and the foreign influences are the principal detrimental factors" (KC. n.d.). He further asserts that 'the deep interest and rivalry of India and China in Nepal's water resources is another concern' (KC. n.d.).

5.1.1. Political instability and people's war: During the 16 years (2008 to present) of federalism, the government in Nepal changed 13 Times; during the 18 years (1990 - 2008) of the constitutional monarchy the government changed 16 times; and during the 29 years (1960 - 1990 AD) of the Panchayat system, the government changed 16 times (Government of Nepal, n.d.). This shows that there has always been political instability in Nepal. On top of this, during these years there have been several people's movements and demonstrations, changes in political systems and rulers. The political instability caused by these factors has led to a lack of national vision, proper planning, and policies for development. For example, three governments right after the country became a republic came up with ambitious plans such as generating 10,000 MW within 10 years (Hydro Review, 2008.), 20,000 MW in 20 years (Bhusal, 2010) and 15, 000 MW in 10 years (Online Khabar, 2018), etc. But they proved to be mere political slogans as those governments lasted for less than a year each and were unable to execute these visions. In such a situation where the national vision, policy, and regulations are always in flux, it is very difficult to build hydropower projects that take many years to complete and need large investments.

Literature suggests that because the parties had to form coalition governments, the political leaders were always in the game of saving their governments or dismantling other parties' governments (ACLED, 2022). In this political chess game, the hydropower sector either got neglected or was used for political and economic gains by individuals and parties. Various hydropower experts considered the political instability as a major factor behind the decade-long load shedding, especially after the political change of 1990.

They also consider the people's war waged by the Maoist Party from February 1996 to November 2006 as a significant factor behind the load shedding (Thapa, D., 2012). The Maoist Party, however, claims that its movement is least responsible for the load shedding as the Party's official policy was to attack only the political infrastructure associated with the then rulers; and not the development infrastructure such as hydropower. Maoists may not have directly attacked hydropower projects, but the various effects of the peoples' war such as obstructions in transportation, forceful donations, *Nepal Bandh,* etc. created a fearful and uncertain environment that was not conducive at all for private investment, both local and foreign. As such, although indirectly, the Maoist movement also delayed the construction of new hydropower projects.

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5.1.2. Lack of capital, technology, market, and foreign influence:

Lack of sufficient internal capital or foreign investment has been a major constraint in the development of Nepal's hydropower sector. Shiva Hari Mainali asserts in an article that one of the reasons for the decade-long load shedding was the lack of internal capital to produce the desired quantity of hydropower (Mainali, 2022). This is a perennial problem in that it used to be the case before the load shedding, during the load shedding, and after the load shedding. However, the lack of capital, particularly the foreign investment in Nepal's hydro, including technology appears to be closely connected with a lack of assured market.

Hydropower projects are naturally capital-intensive. As per current estimates, it costs between Nepalese Rupees (NRS) 20 to 25 crore, to generate one MW of hydropower, although some argue that this estimate should range between NRS 15 to 31 crore (Butchers, 2022). By this estimate, it will cost about NRS 2 trillion to produce 10,000 MW, which is more than the entire annual budget of the country (NRS 1.79 trillion for the fiscal year 2022/023) (Gupta, 2022). Nepal's banks and financial institutions do not have such resources. In addition, they have almost exhausted their capacity to invest in hydropower projects. This means, the growth of Nepal's hydropower sector largely depends on foreign investment. Foreign investors have made attempts to meaningfully engage in Nepal's hydropower for decades but have not been able to invest in a significant way. For example, Indian company GMR, who signed the Project Development Agreement for the Upper Karnal Hydropower Project (installed capacity 900 MW) in September of 2014 AD, was supposed to complete the project within 7 years. However, the company could not even arrange finance (financial closure) within that period (Spotlight, 2022). GMR is not alone, several other foreign companies have attempted to engage in large-capacity projects in Nepal's hydropower sector but have not been able to arrange finance.

The main reason for this is the lack of an assured market. Nepal's domestic market is quite small, particularly for large projects, and the only other market where Nepal's electricity can be sold is the Indian market. India has been imposing different kinds of restrictions on the free flow of electricity between Nepal and India (Poudel, S., 2022). In negotiations, India raises security and other concerns, but the real reason for these restrictions is the lack of trust between the two countries.

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Nepal's inconsistent behavior on various occasions including the so-called "China card", infuriates India. Whereas India's attitude of trying to exert control on every aspect of Nepal's affairs is often described as "Big Brother Attitude" in Nepal. Further, India appears very eager to sign agreements with Nepal to implement development projects; but does not complete them for years, sometimes for over 20 years. For example, the Mahakali Hydropower Project signed in February 1996 has not been completed mainly due to negligence from the Indian side (Bagale, 2020). The Nepalese public considers this behavior as India's deliberate effort to exert a chokehold on Nepal's development. Discussions with Indian experts, however, reveal that India is not against Nepal's development at all, but feels a need to have its signature in Nepal's large-scale projects so Nepal does not let India's adversaries come and work on them at the cost of India's national security. There are several other issues such as the above that build distrust between the two countries.

This attitude of India is displayed even more strongly when it comes to the development of Nepal's hydropower, because India considers, as a lower riparian country, that they also should have a say in how the waters of Nepal's rivers should be utilized (McIntyre. 2013). All of Nepal's rivers flow into India, and as per international laws and practices India, as a lower riparian country, has certain rights on how the waters in these rivers are utilized. When Nepal and India have a heart-to-heart conversation to resolve these issues and build full trust as it used to be in old times, India will open its market for Nepal's hydropower, which can absorb all of Nepal's hydropower potential. It is in India's best interests to import hydropower from Nepal for various reasons including managing their carbon footprint (Tyagi, 2020). When the unlimited market opens, unlimited finance and technology will flow in. In short, the key to Nepal's hydropower development is in the joint hands of Nepal and India. The Sooner this is realized better it is for both countries.

It appears that the growth of Nepal's hydropower sector is entangled in the vicious circle of market, capital, technology, and the Nepal-India relationship. Without an assured market, international investment and technology are not available for large-scale projects and without building full trust with India, large-scale markets cannot be assured for investors. **Since the decade-long load sh**edding, Nepal has made significant progress in the implementation of new projects and power generation. Currently, Nepal's total generation capacity is about 2800 MW (Shrestha, P., 2023), and several projects that have a combined capacity of about 5000 MW are near completion (Shrestha, P., 2023).

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As such, very soon the domestic production will be sufficient to meet domestic needs, even in winter when the production declines by over 50%. In the past, insufficient production in the winter was a problem (requiring import from India) and shortly, the problem will be excess production in summer (requiring export to India). If this excess production cannot be sold, the NEA will incur a huge loss, which may pass on to investors and banks, which can shake the very foundation of the national economy. On the other hand, if Nepal pursues the Panchayat Era policy of developing small and micro hydro projects, this most important natural resource of the country will go to waste. Whether load shedding or not, this vicious circle will always haunt Nepal's hydropower sector.

5.1.3. Corruption: Various hydropower experts, authors, and government officers have also identified corruption as one of the major causes of load shedding. It has been noted that the corrupt nexus between commission agents, politicians, and government officers has resulted in various negative impacts, including delays in the completion of new hydropower projects and supply shortages (My República, 2016).

It appears that corruption took place while delivering services as well as at the policy level. Corruption in the service delivery process took place while providing new electric connections to households, reading meters, transferring electric poles, increasing the amperage capacity, and so on. It was also alleged that the bribes were taken mostly from industrial customers by tempering their meters. An article published in Kantipur on Magh 17, 2073 (19 January 2017 AD) entitled Transfer of 2500 staff to Control Electricity Theft, sheds light on how corruption took place at the service delivery level during the decade-long load shedding (Baniya, 2073 BS). Some examples of policy corruption include making policy decisions that increased the demand for alternative mechanisms of power supply such as inverters, batteries, and solar panels, taking bribes while negotiating PPA, and providing 'a 24-hour supply' of electricity to large industries during load shedding. This scheme of providing unlimited access to electricity to selected industries was a scam involving billions of rupees. Businesses and commission agents would bribe officials to make decisions that would increase the demand for inverters, batteries, solar heaters, and so on. This suggests that there was a significant level of corruption at service delivery as well as policy level that hindered the timely construction of new power plants and contributed to the load shedding. In addition, the general perception during the load shedding was that instead of increasing the supply of electricity, the corrupt officials were creating artificial supply shortages to enable corruption.

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5.1.4. Obstructions and political interference: Several experts on hydropower in Nepal argued that the single most important reason for the decade-long load shedding is the obstruction created by the so-called NGOs and civil society organizations in the construction of the Arun Three Project (Mahat, 2019). The leaders of the obstruction, however, argue that obstruction was necessary because the cost of the project was too high. This project, with a total capacity of 440 MW was being studied by the World Bank, and construction of the first phase was supposed to be completed in the year 2060 BS with the World Bank's finance (World Bank Group, 1994). This project was later negotiated with Sutlej of India, arguably in more stringent terms. This may be the most consequential case of obstruction faced by Nepal's hydropower, but the sector has experienced interruptions from many other sources, including environmentalist organizations; local communities and vested interest groups; local units of political parties; NGOs, INGOs, civil society; and various units of the government.

Local communities and vested interest groups created road obstructions and staged strikes asking projects to build schools, roads, or other infrastructure in their villages. Village-level cadres of political parties would not let the construction work proceed unless the hydro projects would pay donations. Other noted obstructions came from various units of the government itself. It was alleged that the forest department was purposely delaying to issuing permits to clear trees and bushes from project areas or where transmission lines needed to be built. In some cases, the court system also impeded the construction by delaying in giving judgment in related disputes, allegedly to force into bribery. Stories of such obstructions in all aspects of hydro infrastructure development including powerhouses, water canals, transmission and distribution lines, and substations are frequently carried by local newspapers (Khatri, 2080).

It was also alleged that political interference in the operations of NEA caused delays in completing several crucial power projects. Such interference included forcing the NEA to hire cadres of political parties, using NEA's vehicles and other assets by ministers, changing the leadership abruptly, and so on. One such example was the replacement of the entire leadership team of Chilime Second (Nepal Energy Forum, 2014). The project consisting of four powerhouses (Syanjen, Upper Syanjen, Rasuwa Gadhi, and middle Bhotekoshi) was on a fast track to add 270 MW to the national grid by 2071/72 BS. However, because of this abrupt change in the entire management, the project could not be completed on time. It took time for the new leadership to take momentum and rebuild the morale of the entire team. The completion of the project was further delayed by the earthquake and floods. Had this project been completed in 2071/72 as planned, the impact of the decade-long load shedding would have been substantially reduced, if not eliminated.

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The completion of the project was further delayed by the earthquake and floods. Had this project been completed in 2071/72 as planned, the impact of the decade-long load shedding would have been substantially reduced, if not eliminated.

5.1.5. Poor visioning, plans and policies, and operational inefficiencies: Various authors have pointed out that another reason for the supply shortage is the faulty vision, plans, and policies of the government. Highlighting this issue, RS Shrestha argues, "faulty vision and policies of the government of Nepal are the main reasons for decade-long load-shedding" (Shrestha R., 2011). Expressing this dissatisfaction with the vision and policies of the post-Panchayat governments Mr. Shrestha pleads in favor of the Panchayat Era philosophy that identified cooperation and collaboration with India as anti-national and proposed mini and micro projects aimed to meet local demand. He says, "To resolve it, the government must embrace a correct vision that leads the country to self-reliance and should adopt forward-looking policies." (Shrestha R., 2011). However, the post-Panchayet era hydropower experts of Nepal disagree with this assertion. They argue that the Panchayet Era's conservative vision and policy, and the anti-India rhetoric may have been one of the major factors responsible for the decade-long load shedding. As evidence to this assertion, they argue that during the 29 years of the Panchayat Era, only 245 MW was generated, while during the 19 years of Parliamentary Democracy, the generation capacity had increased by 477 MW, and during the 16 years of the Republican Era it had increased by 2050 MW (Nepal Electricity Authority, 2023).

However, other data support the overall assertion made by Mr. Shrestha regarding poor vision and policies. The vision, policies, and strategies of the government regarding hydropower development have been questionable not only in the Panchayat Era but also in the post-Panchayat Eras. For example, during the Republican Era, three governments announced ambitious, long-term visions and plans while their tenure was less than a year: generating 10K MW hydropower within 10 years; generating 20 KMW within 20 years; and generating 15K MW within 15 years (Hydro Review, 2008; Bhusal, 2010; Online Khabar 2018). These so-called visions appeared to be mere political stunts since they were not followed by concrete strategies, policies, and programs.

Poor discharge of duties by various departments of the government, NEA, and other regulatory institutions is also cited often as one of the critical factors hindering the growth of the hydropower sector.

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It has been noted that 'the government announced over 27 relief and promotional programs in the past 16 years, but their implementation has been very poor. For example, 16 programs, out of the 27, were never implemented and only 3 of these programs were implemented fully' (Adhikary, 2022. p.62).This has created massive mistrust in the government and instability in the power sector.

Operational inefficiencies of the NEA during load shedding included, poor PPA negotiations, poor capacity management, faulty utilization strategies, staff management, selection of easier ROR projects over PROR and storage projects, and so on. These inefficiencies directly contributed to the decade-long load shedding. The efficient management of these very factors later by NEA under the leadership of Kul Man Ghising contributed to the end of the decade-long load shedding.

5.2. Significant expansion in demand: While the general narrative was that the decade-long load shedding was caused by inadequate power generation and inappropriate supply policies of NEA, the literature showed that an equally important cause of the load shedding was a significant expansion in demand for electricity, especially after the political change of 1990 AD. As the table below shows, while only 17% of the people had access to electricity just 11 years before the load shedding, it reached 56% of the population in 2008, two years into the load shedding (MacroTrends, 2024). The per capita consumption also increased from 35 KWH to 83 KWH, almost a threefold increase, during this period (The World Bank, 2024). Similarly, the total generation capacity also increased from 248 MW to 725 MW during the 19 years of constitutional monarchy, a period leading to the decade-long load shedding.

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Table 3: Access to Electricity and Per Capita Consumption Before Load Shedding

	Till the end of Panchayat Era (2046 BS; 1990 AD)	Till the end of constitutional monarchy (2065 BS; 2008 AD)	present
Access to electricity	17.9% (1996)	55.96% (2008)	88.9% (2021)
Per capita consumption KWH	34 (1990)	83 (2008)	153 (2022)
Incremental capacity MW	244 (1960-1960)	477 (1990-2008)	1436 (2008-2022)
Total capacity MW	248 (1990)	725 (2008)	2161 (2022)

Sources: Nepal Electricity Authority, Official Records, The World Bank, 2024

Not only the generation capacity increased by 477 MW right before the load shedding (1990 - 2008 AD), but also it increased during the load shedding. In these ten years of load shedding (2007-2017 AD) 38 new projects had been completed, which added 237 MW to the national grid (Nepal Electricity Authority, 2023). This further proves that rapid growth in the demand for electricity was indeed an important factor that contributed to the load shedding.

The demand for electricity in the industrial sector was increasing even more rapidly. With the start of the multiparty democracy, the country adopted the free-market economy, and the government broke several restrictions supposed to be hindering the growth of the private sector. This not only opened doors for the private sector to engage in the production of hydropower (Regmi, 2022) but also increased its demand in the industrial sector. Replacing diesel by electricity could cut the energy costs of industries by two-thirds. With such a potential, it was natural for the demand for electricity to increase in the industrial sector. Professors of the Pulchok Engineering Institute, Bawaraj Bhattarai and Ishwar Bajracharya mentioned in one of the publications of the Institute that the demand for electricity in the industrial sector would increase 2.4 to 3 times annually between 2005 and 2030 (Bhattarai, 2015), which includes the years leading to the load shedding. As such, inadequate supply was probably the main reason for the decade-long load shedding, but a rapid increase in demand also significantly contributed to it. This raises a pertinent question: why did the demand for hydropower rapidly increase just before the start of the load shedding?

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The records suggest that the demand for electricity exploded, especially after the political change of 1990. This can be attributed to several factors, including the democratic government's commitment to provide access to electricity to all citizens. In addition, the political change raised peoples' development expectations and established access to various public services as a constitutional right. This encouraged people to assertively claim their rights, including access to electricity. The investments in dramatic expansion of transmission infrastructure also increased the geographical coverage, which increased the overall demand (Thapa, K. 2068).

The literature pointed to the perception that the decade-long load shedding occurred mainly because new hydropower projects were not being built fast enough. Records of NEA show that prior to the load shedding several projects had been built and the generation capacity had almost tripled. During the load shedding several new projects were added to the national grid. So, although the supply had increased before and during the load shedding, the increased supply was not enough to meet the increased demand, which had skyrocketed due to political and economic changes in the post-Panchayat Era. The authorities should have been able to project this growth in demand in the post-Panchayat Era and planned accordingly, but that could not happen for various reasons as described in section 5.1 above.

6. Data Analysis, Discussion, and Interpretation

6.1. The cost of the load shedding to the country: an estimate

The decade-long load shedding resulted in heavy costs to individuals as well as the national economy. It was a significant setback in the development of the country. Primary data was collected to find out how it impacted the households financially, and what measures had been taken to cope with the impact of the load shedding. This was done by interviewing 176 households who had been the customers of NEA at the time of the load shedding. They were asked what measures they had adapted to deal with the problems of load shedding, and what was its impact on their expenditures and investments. The results are summarized in the table below:

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Table 4: Measures Adapted by Households and Costs

	Measures	Average annual expenditure NRS	Average cost over the ten years NRS
Short-term measures	Candles, Chargeable electric lamps, emergency lamps that light when power shuts down, Thermos for hot water and food, Power banks, DC fans, Kerosene stoves and	22,838	251,212
Long-term measures	Solar light, Solar water heaters, Inverters, Inverter batteries, Solar chargers for inverters, Diesel generators, Induction stoves, etc.	374,000	748,000
		Total expenditure per	999,212

Source: Survey data

As the table above shows, the households used short-term and long-term measures to lessen the impact of the load shedding. Short-term measures include using candles, electric lamps, and emergency lights; power banks to charge phones; thermos to store hot food and water; and kerosene stoves and firewood to cook. Long-term measures included investments in solar lighting and heating systems, inverters to store power in batteries, diesel generators, and induction stoves. The data shows that they spent an average of NRS 22,838 per year on short-term measures. In long-term measures, NRS 748,000 was spent on average by each household during the entire period of the load shedding. As such, in the ten years of load shedding one household spent about NRS 10 lakhs on average on both short-term and long-term measures. Since NEA had about 35 lakh customer households during that time, the total financial loss at the household level was about NRS 350 Arab (or US$ 35 billion). In addition, the affected households reported a loss of about 10% in their household income.

Estimating the impact of the decade-long load shedding on Nepal's economy, Govinda Timilsina, et. all. wrote a working paper for the World Bank (Policy Research Working Paper 8468). The working paper argues: 'Had there not been the load shedding, Nepal's Gross Domestic Product would have been seven times higher, and investment would have increased by 48% in each of these load shedding years.

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Because of the stagnation in investment, industrial production declined by about 7%. The imports and exports also declined in each of those years by an average of 5.4% and 2.8% respectively. As per this study that used the Computable General Equilibrium Model to make these estimates, the load shedding in the nine years (from 2008 to 2016) resulted in a decline in Nepal's Gross Domestic Product by as much as US$ 11 billion (Timilsina, 2018).**Most of** the responding households mentioned that in addition to the economic costs, the social and emotional costs were heavy in terms of mental stress, having to endure winter cold, disruptions to students in their studies, and having to reschedule domestic chores and professional work according to the schedule of the load shedding. Especially heart-wrenching was the widespread belief among the populace that the authorities had taken bribes from traders and blackmailed the customers into purchasing solar power systems, diesel generators, investors, and truck batteries at abnormally higher prices.

6.2. Why did the load-shedding end in a miraculous fashion?

The decade-long load shedding, which had shown no signs of ending anytime soon, ended suddenly within months of the change in the leadership of the NEA. To find out what really ended the load shedding, this research interviewed various stakeholders of hydropower. The research also conducted a questionnaire survey asking NEA customers and the public about their views. The study found that the public, the experts, and the hydropower entrepreneurs did not appear to have the same understanding as to how the load shedding ended.

6.2.1. General Public's Perceptions.

The customers of NEA, or the public identified several political, technical, and management reasons that ended the load shedding.

Table -5: General Public's perception of How the Load Shedding ended.

S.No.	Reasons	Number of respondents	% of respondents
1	Strong commitment, and right skills of the new leadership of NEA	160	91
2	Selection of right leadership for NEA by the political leadership.	140	80
3	Control in corruption	118	67
4	Increases in power generation	102	58
5	More power imported from India	98	56

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As the table above shows, a large majority of the respondents (customers of NEA) thought that the strong intention and resolve as well as management acumen and technical expertise of the new leadership at NEA was probably the single most important reason responsible for the end of the load shedding. Almost equally important was the political commitment of the new government to end the load shedding, because without this the NEA management would not have been able to enforce the tough decisions that they took. The public also credited the government for identifying and employing the right leadership at NEA as per the needs of that time. The tough steps taken by the new management to control bribery in the delivery of services such as transferring 2500 staff, additional power import from India, and completion of new projects were also identified by the public as other reasons contributing to the control of the load shedding.

6.2.2. Perceptions of Experts and Entrepreneurs

Several hydropower experts in Nepal and hydropower entrepreneurs who were interviewed during this study said that the role of the new management, particularly the new Managing Director Kul Man Ghising, was not that significant in ending the load shedding. Some argued that load shedding was going to be resolved on its own as more power was coming into the system. Regarding the reasons for the end of the load shedding, this group of respondents suggested the following: right about that time the generation capacity had increased (110 MW added); more than usual amount was imported from India (50 MW more imported); transmission systems had been upgraded to make it easier to import from India, and improvements were made in management, particularly the demand side management.

As argued by the experts, the addition of power to the national grid right around that time and an additional import of 50 MW from India must have helped, but just this would not have been enough to end the load shedding.

6.2.3. What really happened: The inside story of how the load shedding ended?

The opinions of hydropower experts, entrepreneurs, and customers of the NEA were important to shed light on how the decade-long load shedding ended. But to complete the picture they painted; it was necessary to hear from the ones who actually did it. Hence, Key Informant Interviews (KII) were conducted with the Managing Director of NEA, members of his senior management team, and several members of the Board of Directors of NEA as well as previous ministers of Energy, Water Resources, and Irrigation. Content analysis of these interviews showed that they had applied at least eight strategies to eliminate the load shedding (table - 6).

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Table 6: ***Strategies Deployed to End the Decade-long Load Shedding***

1	**Change in public perception and mobilization of support**
2	Addressing the harsh reality of the load shedding causing more load shedding
3	Optimum utilization of the existing capacity
4	Ending the dubious power trade
5	Import management
6	Control of theft and leakages
7	Improvements in transmission and distribution infrastructure
8	Human resource mobilization

While implementing these eight strategies, the new management had also addressed deeper level issues such as how load shedding was, in fact, contributing to making it harsher; how NEA's own communication strategies had been counterproductive; how the perceptions of the public needed to be changed; and why a wider participation of the general public was essential to end the load shedding.

These Key Informant Interviews also revealed that the management of NEA had been able to implement these strategies because of strong mandate and support from the government to end the load shedding. On August 4, 2016, a new government took over led by the Maoist Chairman Prachanda, at a time when the popularity of the Maoist Party had been continuously sinking. This was the second time Prachanda had led the government, and this was perceived by the leadership as the last opportunity to revive the image of the party. Prachanda had to do something that would reestablish the party's popularity before the forthcoming general election. He had chosen his confidant and a party leader to lead the Ministry of Energy, Water Resources, and Irrigation. Within two months, the new government decided to replace the management of NEA with Kul Man Ghising. Sidelined from the management of NEA for quite a while due to political and professional differences, Kul Man Ghising, was keenly motivated to reestablish his professional integrity and capability. An engineer by training and an astute manager, Kul Man Ghising was appointed as the Managing Director of NEA on Bhadra 29, 2073 BS. Seven weeks later the day of Laxmi Puja, the day on which the domestic demand for electricity is at its peak, Kul Man and his team were able to avoid the load shedding. Some seven months later NEA declared the end of domestic load shedding and about a year later (in May 2018) industrial load shedding. In these seven weeks until the **Laxmi Puja**, what did Kul Man's team do? How did the load-shedding end in seven months? Had this been possible due to sharp strategies and astute management or this was a coincidence? The implementation of the eight strategies sheds light on these questions.

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6.2.3.1. Change in public perception and mobilization of support.

The new management under the leadership of Kul Man Ghising, started its mission by initiating various measures of demand side management but quickly realized that to control load shedding it was essential to change the prevailing perception of the public. The public at that time believed that the load shedding was inevitable and was not going to end anytime soon. It was necessary to change this perception because it was making the load shedding far worse than justified by demand and supply conditions. Various measures were taken to change this perception and raise public confidence in the new management's efforts to reduce the impact of the load shedding. For example, the practice of announcing weekly schedules of load shedding was discontinued, because the load shedding schedule was raising peoples' skepticism rather than confidence in the NEA, which raised the peak hour consumption and wastages.

This was followed by providing electricity in all locations of Kathmandu uninterrupted for 24 hours as if the load shedding had ended. This was a risky experiment, which was started without any announcement. NEA was able to do this for 15 days without any problem. While still in experiment came the Laxmi Puja, the day on which the peak consumption is highest, and on this day also there was no outage in any part of the Kathmandu valley. After this success during Laxmi Puja, it was announced that there would not be load shedding in Kathmandu Valley. To make the experiment successful, the NEA had to divert some power from the industrial market to the domestic market during the peak hours. Initially, it was done for 6 hours a day, and later it was reduced to 4 hours. After Laxmi Puja, when the power was received by each household uninterrupted for a month, people started to trust that the load shedding was indeed going to end. Within a few weeks, on the 20th of Mangshir, the people of Kathmandu Valley congratulated the NEA and asked how this had been possible.

It was vital to raise this trust among its customers to end the load shedding permanently. During this experiment, the NEA also reinforced the value among its staff that for NEA's success, it is important to win the trust of the public and ensure their support. As such, the campaign to end the decade-long load shedding was built on the belief that the successful management of power in the country depends not only on the proper management of its technical and business aspects but also on mutual trust, support, and cooperation with the public.

The demand and supply adjustment had eliminated load shedding in Kathmandu valley, for the time being. But making it permanent, ending the load shedding from the entire country, from the industrial sector, and even during the winter was the toughest challenge, and NEA needed to be a lot more innovative. After the success in Kathmandu Valley, the NEA started to work on ending the load shedding from Pokhara, Bharatpur, Butwal, Biratnagar, and ultimately from the entire country.

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6.2.3.2. Addressing the harsh reality of the load shedding causing more load shedding:

To be able to eliminate load shedding in the long run and throughout the country, it was necessary to address the elusive issues such as how load shedding was aggravating load shedding. A deeply experienced engineer and highly committed manager, Kul Man Ghising detected this elusive issue early on.

Explaining this phenomenon, he said that because of the load shedding many household customers used to store electricity in large batteries (up to 20 KW) using inverters. When the electricity would be supplied for a short period as per the schedule of the load shedding all customers of that area used to charge these batteries, pump water, iron clothes, charge all other electrical appliances, and so on. This would push the peak load to its highest. For example, the normal peak load of Kathmandu at that time was about 400 MW, but due to load shedding, it used to reach 600 MW. Similarly, the normal peak load of Bhaktapur at that time was about 14 MW, which used to reach 28 MW due to load shedding. The successful management of power distribution depends on how well the peak loads of the 24-hour cycles are managed. If the peak load at one time in the 24-hour cycle is excessively high compared to other times it brings several problems. First, it is difficult to meet peak demand if it is significantly higher than normal demand. Second, if the generation and distribution capacity is increased to meet such peak demand, the production at other hours goes to waste. The excessive peak demand can also cause transformer damage, burning of wires, and so on, which increases load shedding. As such, if peak load is reduced, the severity of load shedding can also be reduced. However, due to existing practices, the load shedding was increasing the peak load to its highest level and making the load shedding worse.

The load shedding was not only increasing the peak load, but it was also causing a waste of a lot of electricity, which further aggravated the load shedding. Experience has proven that 20 to 30 percent of the power stored in batteries through inverters is wasted. It was estimated that due to this waste about 120 MW of electricity was being squandered in Kathmandu alone. To eliminate this wastage from the system, it was necessary to eliminate consumers' need to store electricity in batteries. As a trial run, this was done by suspending load shedding for 15 days so people would not feel a need to store. People responded as hypothesized by the trial run; within days this loss was reduced from 120 MW to 18 MW, an 85% reduction. As the peak load started to decline so did the losses from transformer and wire damages. This saving in electricity made by managing the peak load not only helped to reduce the severity of load shedding in the short run and to end the load shedding ultimately but also helped to reduce the heavy financial losses that NEA was incurring at that time.

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Once the batteries and inverters were removed from the system, the peak demand was further reduced by making a public appeal. This appeal was made through public media and schools, which asked the consumers to avoid, as much as possible, pumping water, ironing clothes, and other such high-energy uses during peak hours. The public responded positively to the appeal, and the peak demand declined further.

These efforts made the demand for pick hours almost equal to the demand for other hours. Thus, winning the trust of the public, and changing the consumption habits and practices of customers were also used as strategies to eliminate the load shedding, in addition to the technical and management strategies.

6.2.3.3. Optimum utilization of the existing capacity: Since the predominant narrative was that the cause of the load shedding was delays in developing new hydropower projects, optimum utilization of the existing capacity had been neglected. However, the new leadership started to investigate possibilities of increasing production and supply from the existing capacity.

One such opportunity was to explore which ROR (Run-of-River) projects could be transformed quickly into PROR systems, or could also be used for peaking, and what would that call for. In a ROR system, the amount of electricity is produced based on the amount of water flowing in the river. But in a PROR system water is stored to maximize production during the pick hour(s). As such, in the case of PROR systems more electricity can be produced than the normal flow of water allows, but only during chosen hours. Doing this would reduce the severity of the load shedding because the supply during the pick hour could be increased significantly.

The management team discussed this possibility thoroughly and based on the fluctuation of demand in a 24-hour cycle, decided to execute a plan that would allow NEA to produce an additional 450 MW during peak hours. The projects chosen to execute this peaking plan included Middle Marsyangdi (69 MW), Marsyangdi (70 MW), Upper Marsyangdi (50 MW), Modi (14 MW), Kali Gandaki (144 MR), Chilime (20 MW). Thus, up to six projects needed to be transformed from ROR to PROR projects, and that would require significant repair work.

The existing practice was to pay a 150% (of salary) allowance to repair staff, and it used to take about 48 days to repair one project. This pace of repair would take 288 days, to transform the six projects from ROR to PROR. An internal study showed that the repair time of one unit could be reduced by 67%, or to 16 days from 48 days without making any compromises on the technical aspects. This would reduce the total repair time from 288 days to 96 days. But repair staff were not prepared to speed up the repair work, because the more days they spend in repair, the more allowance they would be getting. Repair work used to be deliberately delayed by repair staff to make additional income.

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To break this unproductive practice, the management introduced a new incentive policy of paying a 300% (three times the salary) allowance if the repair work of one project is completed in 16 days. The new allowance policy worked, and arrangements were made to increase peak hour supply significantly. Because of these changes, however, the nighttime production of some of the projects had to be reduced, which resulted in nighttime load shedding for a few hours in some districts.

6.2.3.4. Ending the Dubious power trade : Another significant reason that aggravated the load shedding was the 24-hour supply of up to 370 MW of electricity to selected industries through the trunk and direct lines. It was argued, to justify this decision, that ensuring an uninterrupted supply of power to industries was necessary for the country's industrial development. Another justification presented was that since these privileged industries had agreed to pay an additional charge of 65%, this would increase NEA's revenue significantly.

However, many suspected that behind this scheme there were ulterior motives of the participating industries and those in power making this decision. Correcting this decision would help reduce the severity of load shedding, and hence the new management made this a key aspect of the supply-side management strategy.

This discriminatory policy enabled some selected industries to receive an uninterrupted supply of power for up to 19 hours a day, while other industries and the public were receiving a limited amount of power only for 5 to 6 hours a day. The privileged industries were receiving as much electricity as they wanted and were able to make millions of rupees of profit. For example, at that time one unit of electricity costing about Rs.10 could replace diesel costing Rs. 30 to 35. Based on this cost scenario, it was estimated that an industry could save up to Rs. ten million (one crore) in a month by using just one MW of electricity from NEA in place of diesel. This means industries having access to 40 MW from NEA were making up to Rs. 400 million (or NRS. forty crore) additional income every month. Since the amount of power thus diverted to selected industries was about 370 MW, the total monthly gain from the scheme was about Rs. 3 billion and 700 million (or NRS. 3.7 Arab). Those aware of the inner mechanics of the scheme dubbed it 'a dubious trade of electricity in the name of industrial development' and called this an example of policy corruption.

The new leadership at NEA tried to discontinue this scheme but faced resistance from various actors, including some units of the government. The issue was then presented to the Lekha Samiti (Accounts Committee) of the Parliament, which instructed NEA to discontinue the scheme. This allowed NEA to divert 370 MW of electricity towards ending the load shedding. Despite the directives of the Lekha Samiti of the Parliament several heavy industries and hospitals lobbied to reinstate the scheme. As per the NEA, several industries that benefited from this scheme have refused to pay some of the dues till today (Poudel, 2023).

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6.2.3.5. Import Management: Power trade with India is critical in both ensuring a regular and adequate supply of power in the domestic market (or avoiding load shedding) and controlling potential losses from wastage of power during the rainy season. Since most of the hydropower projects of Nepal are ROR-based, its winter production is almost one-third of the summer production. Nepal in general imports power from India during winter and sells to India during summer. With the steady growth in the generation capacity, this situation is going to change soon. The country's winter season demand will also be met by its own production. But during the decade-long load shedding, Nepal had no option other than importing from India at least during winter.

Some experts of hydropower in Nepal had claimed that the new management of NEA had dealt with the load shedding by importing power from India. And indeed, the new management had imported an additional 50 MW. However, the new management of NEA did not believe that the decade-long load shedding could be ended just by importing from India, nor was this an appropriate strategy. As such, the management team that was looking into every possible opportunity to end the load shedding identified import management as a critical component of the overall strategy. As a short-term strategy the management decided to import a small amount of additional power, 50 MW more than what was being imported. But as a long-term strategy, the management decided to make import and export fast, easy, dependable, and cost-effective. Within months, the new management requested and convinced India to install an 80 MW transformer in Muzaffarpur, India. In addition, through meetings with Nitish Kumar of Bihar and Yogi Aditya Nath of Uttar Pradesh as well as with executives of various government agencies of India an understanding was reached to improve and upgrade the transmission lines connecting Nepal and India.

6.2.3.6. Control of theft and wastages: The leadership of the NEA noted that the amount of theft and leakage of electricity was unusually high, which needed to be reduced if not fully controlled. This could have a significant impact on ending the load shedding. It was estimated that the theft and leakage amounted to about 26% of the total production (Kathmandu Post, 2017). Since the total production capacity at that time was about 560 MW, almost 146 MW was being lost to theft and leakages. The new management executed aggressive strategies aimed at rapidly reducing this wastage.

While the power theft was being perpetrated by the customers as well as the staff of NEA, the major loss was attributed to a corrupt scheme, which was being enabled by some front-line staff of NEA. As per the scheme, some meter readers and front-line workers, who were involved in this plot, would allow connections of electric lines bypassing meters. To break this unholy alliance, the NEA management transferred some of these front-line staff from the areas that they were serving.

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Since these staff were members of various trade unions affiliated with major political parties, they tried to politicize the issue and defy the management decision. However, the NEA management had fully prepared to deal with the resistance. Before transferring these staff, the management had prepared a theft report and had used it to take law enforcement agencies and political leadership into confidence. Within days, under the direct order of the then chief of Kathmandu police,16 suspects were arrested. A week later, 2500 staff members were transferred (Bizmandu, 2017). This action encouraged other staff and instilled a sense of loyalty and honesty. Despite such tough action, several front-line workers did not go to new areas to read meters. To counter it, the management asked the customers, through public announcements, to read their meters themselves and come with the reading to pay the bill. As a result of these steps, theft was reduced from 26 % to 20% immediately, and in some areas, it went down from 40% to 5%. (Nepal Electricity Authority, 2018) In the long run, other strategies were also adapted, which brought the theft down to 15%. It was also found that those who stole electricity were wasting a lot of it. Hence, a reduction in theft led also to a reduction in wastage. This not only increased the amount of electricity at NEA's disposal but also resulted in significant financial gain.

6.2.3.7. Improvements in transmission and distribution infrastructure: The nation was consumed in various debates and propaganda about the load shedding. The public increasingly believed that a major cause of the load shedding was economic mismanagement at the very top. Some had started to allege that the authorities seemed to be perpetuating load shedding rather than attempting to end it. The authorities, on the other hand, were busy convincing why the load shedding was inevitable. In this chaos, the transmission and distribution infrastructure were neglected. In the ten years of the load shedding, transformers and wires had become too old; there were significant delays in upgrading substations; the capacity of transmission lines was almost stagnant; and transformers, wires, and supplies had not been procured in two years. This poor state of transmission and distribution capacity was also contributing to the load shedding. Without significant improvements in this infrastructure, the load shedding could not be ended in the long run. To end this situation, the NEA leadership improved inventory management, replaced old transformers with new ones, upgraded the capacity of existing substations and transformers, and built new substations. The transmission capacity increased from 26,000 kilometers to 41,000 kilometers in a short period. Experts believe that transmission and distribution infrastructure is still a bottleneck in the growth of the hydropower sector in Nepal. But the above improvements contributed, at least at that time, to ending location-specific load shedding caused by inadequate transmission and distribution infrastructure.

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6.2.3.8. Human resource mobilization: As discussed above, the various steps and strategies undertaken to end the load shedding were indeed challenging and could not have been implemented without the support of capable employees of NEA. As such, the role of its workforce in ending the load shedding was incalculable. However, to ensure support and effective performance from its pool of qualified staff, NEA leadership had to take several firm steps.

What drew instant attention was the firing of 16 corrupt staff and the transferring of 2500 others. This reestablished the chain of command. Through various management decisions, productive behavior was rewarded, and unproductive behavior was discouraged. For example, several committed, honest, and effective staff were rewarded with various incentives, including promotions. It became very clear to all employees that defying management decisions had severe consequences and cooperating to achieve the goals and targets of the organization had rewards. This enabled the management to deploy its human resources as needed and in any unit of the organization.

The employees who were effective, disciplined, and positive, who happened to be about 10%, were encouraged as change leaders. The bottom 10% who were disruptive, undisciplined, and unhinged were put on notice but were given a second chance to improve. The remaining 80% who generally followed the change leaders were encouraged through various incentives. After seeing the disciplined and effective staff rewarded, the disruptive staff also started to become, although slowly, disciplined, and responsible. As milestones towards ending the load shedding were being achieved, the public started to pay respect to NEA and its staff.

These changes brought a positive change in the organizational culture of NEA. The values such as trust, responsibility, morality, and loyalty were firmly established. The overall morale of the staff improved, and so did their overall productivity. To support the improving culture, staff morale, and motivation, a new incentive policy was announced that included a 60% (of base salary) allowance and employee insurance for all staff.

The various strategies deployed with the main objective of ending the decade-long load shedding resulted in the end of the household level load shedding from the entire country within seven months and industrial load shedding within another year. Highlighting this phenomenal achievement The Kathmandu Post wrote, "Having lived through what is anecdotally called the "dark ages" between 2006 and mid-2017, when we survived power outages lasting up to 18 hours a day" (The Kathmandu Post, 2021). However, the results of these efforts have extended far beyond the end of load shedding. For example, in the 16 years before 2073 BS, the NEA was incurring losses every year, which resulted in an accumulated loss of NRS 35 Arab. However, after the above changes, NEA's annual net income reached NRS. 13 Arab, which contributed towards bringing the accumulated loss to zero.

While the management was implementing the above eight strategies, a conducive environ-

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While the management was implementing the above eight strategies, a conducive environment was being created by the government so that the NEA management could implement these strategies. The key events that took place right after the leadership change in the NEA suggest that the new management had taken over the leadership of the NEA with a clear mandate of resolving the problem of load shedding, and the government was fully behind it. The load shedding did not end on its own, as many believed; instead, it happened because of a clear mandate from the government and deliberate plan and its effective execution by the NEA, as well as the ongoing political commitment of the government. For example, within a month, the new management prepared a detailed plan to handle the load shedding and decided to begin the process from Kathmandu Valley and extend it throughout the country. The management also took harsh steps such as the transfer of 2500 staff and legal actions against 16 of them on allegations of corruption. Without the Government's firm support, it would not have been possible to transfer 2500 staff and terminate the employment of 16 of them.

7. Are there chances of having similar load shedding in the future?

This question was asked to 176 customers of NEA from Kathmandu as well as various experts of hydropower, and NEA managers. Over 80% of the NEA customers thought that the chances of another load shedding were nonexistent, and the remaining 20% were uncertain. They suggested that in recent years the production of hydropower has increased at such a pace that there is no chance for the demand to surpass the supply. However, the experts and NEA managers argue that the risks of another load shedding do exist, not due to shortages in production but due to problems faced in expanding and upgrading transmission lines and building new substations. The editors of Urja Khabar also warn of this possibility by suggesting that "if transmission and distribution infrastructure is not upgraded, there is a chance for the country to be pushed into darkness again. This problem has started to show up in some cities already" (Urja Khabar, 2022).

The transmission and distribution infrastructure is already fragile and inadequate. In its efforts to provide access to electricity to all households in the country, the NEA has not been able to invest adequately in the transmission infrastructure. The existing infrastructure, particularly in rural areas, is primitive, just like dirt roads. Unless it is significantly upgraded there will be unannounced blackouts due to the burning of wires and transformers. Improvements are needed at the household levels also, particularly on wiring and meter capacity so modern appliances could be used.

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The main obstacles faced in expanding and upgrading the transmission and distribution infrastructure include obstructions from various stakeholders and a lack of investment capital. NEA has been facing obstructions from local communities, NGOs, vested groups, political parties, and some government agencies. There have been multiple cases where security personnel and NEA employees working on transmission lines and substations have been violently chased away by local communities (Seto Pati, 2023). Nepal's forest department (Khatiwada, 2024) and courts have also delayed the construction of several transmission lines due to their red tape and inefficiencies.

More obstructions will be faced in the future from local communities; on one hand, more and more high-tension lines and substations will have to be built in neighborhoods as demand grows, and on the other people want these infrastructures away from their properties fearing that they may have negative health impacts. Just in Kathmandu Valley 25 new substations and several high-voltage lines will have to be built in the next ten years.

Some obstructions may be justified, but obstructions motivated by corrupt intentions, and undue political interests must be stopped if a third load shedding must be avoided. To curb violent obstructions legal measures may be needed, including enforcement of existing laws as well as enactment of new laws. Along with legal measures, appropriate compensation and incentives should also be introduced, especially to offset the losses of people caused by the expansion and upgrading of transmission and distribution infrastructure. Public education and less invasive technologies and policies can also reduce obstructions. If people became fully aware of the fact that their obstructions in the construction of transmission lines and substations can lead to another load shedding, they would think twice. They will not engage in such activities unless they truly suffer financial and other losses, which can be addressed through compensation schemes. NEA should also look for less invasive technologies while developing the transmission and distribution infrastructure such as laying wires underground. More such measures can be found by studying what industrial countries have done to minimize the impact of high-tension lines and substations in highly populated areas.

Developing high-quality transmission lines that connect all cities, towns, and villages within the country as well as the main export market, India, will require significant investment. This will require loans and grants from schemes such as the Millennium Challenge Corporation (MCC) and the Belt and Roads Initiative (BRI), of course without compromising the long-term interests of the country. Since there does not seem to be enough political appetite and expertise to utilize such sources of capital in the best interest of the country, public discourse should start to assess the pros and cons of programs such as MCC and BRI, and what other sources of capital can be utilized.

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8. Findings, Conclusions, and Recommendations

Nepal is believed to have the second-highest potential for hydropower per capita in the world. Thousands of rivers flowing from the high Himalayas through the Mahabharat mountains to the lowlands of Terai in a span of less than 250 kilometers make hydropower one of the most important natural resources of the country. Nepal is also known as one of the trailblazers in hydropower harvesting in Asia for building its first hydropower plant in 1911 AD. However, the progress made over the years in utilizing this most important natural resource of the country is dismal. Various geographical constraints as well as legal, political, technical, and economic challenges have constrained its growth. At present the total hydropower generation capacity of the country is just below 3,000 MW.

The systemic slow growth of the sector and rapidly increasing development aspirations of people have resulted in load shedding at different times. The most infamous load shedding occurred from 2006 to 2017 AD. As such, the load-shedding started two years before the country became a republic and lasted for another eight to nine years. The key findings, conclusions, and recommendations of the research are as follows:

1. ***The causes*****:** One of the key objectives of this research was to find out what caused such a devastating load shedding. The literature gave the impression that the decade-long load shedding occurred because of slow growth in hydropower generation capacity due to various factors such as political instability and people's war, lack of capital and technology, market and foreign influence, and obstructions and political interference as well as corruption and mismanagement. However, this research found that the unprecedented growth in demand for electricity also was equally responsible for the load shedding. The demand for electricity skyrocketed, especially in the post-Panchayat Era for various reasons such as democratic governments' commitment to provide access to electricity to all citizens; the political change and raised development expectations; the increased assertiveness of people in fighting for their rights including access to electricity; and expanded geographical coverage. As such, what caused the load shedding was not only the supply-side factors but demand-side factors as well.

2. ***The economic toll***: The research also found that the social as well as economic toll of the load shedding on the country was very heavy. It was a significant setback in the development of the country. Gross domestic product, national investment, industrial production, and import and export declined by billions of rupees. The financial losses at the household level were also in the billions.

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3. What ended the load shedding: The load shedding that started with 4 to 5 hours of black-out a day and grew up to 16 hours continued for a decade under the watch of several governments of various parties and numerous executive directors of NEA. The whole nation believed that the load shedding was here to stay. And suddenly the NEA declared the end of the load shedding in a magical fashion making everyone wonder how it became possible. This research aimed to find out how the NEA was able to end the load shedding in such a magical fashion.

The research found that the new leadership of the NEA had executed various strategies aimed at ending the load shedding. But there were a series of events that led to a determination to end the load shedding. Just a few months before the end of the load shedding the federal government had changed and the new government had replaced the leadership of the NEA. The new government and the new leadership of the NEA were determined to end the load shedding. The new Managing Director of the NEA, an experienced engineer with shrewd management skills, and the senior management team devised and implemented various strategies directly attacking the load shedding. They not only made improvements in day-to-day technical and management activities but also addressed deeper-level issues such as how load shedding was contributing to making it harsher; how NEA's communication strategies had been counterproductive; and how the incentive system was promoting unproductive behavior. The new management discovered that the load shedding was not happening just because of a lack of technical expertise and management failure but also due to dereliction of duty and wrong motives of the ones in power. These loopholes were sealed. As a result, within seven months of their hard work, the nation became free from the decade-long load shedding.

As such, the load shedding had ended due to a clear mandate from the government to the leadership of NEA, strong resolve and deep experience of the NEA leadership, deliberate plan and its effective execution by NEA, and continued support from the government including security agencies.

5. Load shedding in the future?

While the whole nation enjoyed the end of the decade-long load shading, the NEA leadership and hydropower experts of Nepal continued worrying about the possibility of a similar load shedding in the future. The public does not think that there will be another load shedding because the country has been able to increase its hydropower generation capacity beyond its domestic demand, even in the dry season. However, the experts think that if another load shedding becomes inevitable, it will be due to the challenges being faced in upgrading and expanding the transmission and distribution infrastructure.

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The two key challenges in this regard are the lack of finance and obstruction from local communities, interest groups, NGOs, and sometimes some departments of the government itself. These challenges can be addressed by enforcing existing laws and enacting new laws, introducing a fair compensation and incentive scheme, implementing public awareness campaigns, introducing less invasive technologies, and borrowing lessons from developed countries on how they have handled these issues, particularly in highly populated cities.

6. Lessons: The experience the NEA went through to resolve the chronic problem of load shedding suggests various lessons that can be used to resolve other chronic problems such as the supply of water and provision of public transportation in the Kathmandu valley. Some of the lessons of this experience can be summarized as follows:

a. ***Pressure on the political leadership*** to produce real results that directly impact the lives and livelihoods of the public is very important if some significant chronic development problem must be addressed in Nepal. In this case, the political pressure was about reinvigorating the popularity of a political party in the face of an upcoming general election. The lesson for the public and consumer associations is that they need to actively engage in the development of the country through learning about the issues, participating in public discourses, and creating political pressure through demonstrations, public statements, and voting.

b. Political commitment of the party in government, if not all major parties, is essential to achieve significant transformations such as the end of the decade-long load shedding. Political comment from leadership can come in multiple ways, but the public must engage in the deliberation of their development issues and create political pressure so political leadership is forced to commit in the true sense.

c. Support from the various units of the government is of vital importance because, without full support from the various arms of the government, no major decisions can be implemented. NEA's efforts to end the load shedding became possible due to the unwavering support it received from the various arms of the government including its security agencies.

d. Determined and motivated leadership was probably the most critical element in ending the decade-long load shedding. A few years ago, Kul Man Ghising and his senior management team were removed from the leadership position of the Chilime Hydropower Project, despite their excellent performance, in a controversial manner, arguably for ulterior motives and political reasons. When he became the Managing Director of NEA, it was an opportunity for him to prove again his loyalty to the organization, as well as his business acumen, professionalism, and technical skills. For this and other reasons, he was highly motivated and determined to end the load shedding and was able to transmit this motivation to the senior management team and other personnel of NEA.

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e. Knowledge of the deeper realities *of the business* by the leadership of NEA such as load shedding causing further load shedding also helped to end the load shedding. Along with determination and deep motivation, the leadership must know the business inside out.

f. Astute management, technical know-how, and implementation skills of the leadership were also vital in ending the load shedding. As this research showed, the leadership came up with a concrete plan to end the load shedding, deployed human resources effectively, implemented public campaigns, secured public support, and invented creative solutions to problems.

g. Public support and cooperation. If a major development feat must be achieved, the public must support the sincere efforts of the government or government agencies such as NEA. The public should create pressure on the government to effectively address their problems such as the supply of electricity and water, and delivery of health education and transportation services. But the public should also cooperate when sincere efforts to address these problems are initiated.

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