



Investment in Nepal's electricity market and cooperation strategy of China-Nepal Power Project

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Abstract. The article sorts out the relevant studies on the power market in South Asia, especially the power market in Nepal, and discusses the future development of the power market and the cooperation in the power market. This article analyzes the natural situation of Nepal's hydropower resources, the current situation of the power system, the development of Nepal's power market, the feasibility of power export, the development of Nepal's power market, the investment environment and the risks of the power market, and makes suggestions on the policies and prospects of China-Nepal power cooperation. It provides a reference for the investment units in China's power market and also provides a useful reference for the implementation of the "Belt and Road" strategy, the power cooperation between China and Nepal, and the promotion of economic cooperation between the two sides.

Keywords: Nepal; Hydropower energy development; Electricity market investment

1 Introduction

Nepal is located in the southern part of the Himalayas, bordered by the Tibetan Plateau of China to the north and India to the west, at the northernmost point of the South Asian subcontinent. As Nepal is backed by snow-capped mountains, it has many rivers with large differences in water levels and a hydroelectric energy reserve of 83,000 MW. Due to the low level of infrastructure and development of hydropower resources in Nepal, there is a growing conflict between the supply and the demand of hydropower. In line with this proposal, Nepal's energy sector has announced a hydropower plan to increase Nepal's power generation capacity to 25,000 MW by 2030.

Based on this situation, Nepal has been active in international investment and cooperation, and China is one of Nepal's partners. The Chinese government is actively pursuing the "going out" strategy and promoting the construction of power projects in countries along the "Belt and Road", and has increased its investment in the Nepalese region. For example, China Hydropower International has invested in the construction

of the Upper Tamaksi Hydropower Plant, with a total installed capacity of 456 MW, which has a great impact on Nepal's power supply and energy supply, easing the pressure on Nepal's power supply.

The article sorts out the relevant studies on the power market in South Asia, especially the power market in Nepal, and discusses the future development of the power market and the cooperation in the power market. This article analyzes the natural situation of Nepal's hydropower resources, the current situation of the power system, the development of Nepal's power market, the feasibility of power export, the development of Nepal's power market, the investment environment, and the risks of the power market, and makes suggestions on the policies and prospects of China-Nepal power cooperation. It provides a reference for the investment units in China's power market and also provides a useful reference for the implementation of the "Belt and Road" strategy, the power cooperation between China and Nepal, and the promotion of economic cooperation between the two sides.

2 Literature Review

Research on South Asian electricity markets began in 2004 when Thakur et al. (2004) discussed the regional problems prevailing in the generation and distribution sectors ^[1]. Subsequent studies on South Asian power markets have focused on assessing the potential for cooperation among national power markets by, for example, conducting simulation analysis of regional power markets using generation-transmission maximization models. Singh et al. (2016) studied the regulatory and policy environment of the power sector in South Asian countries in the context of cross-border power trade ^[2]. Among them, Nepal's electricity market is widely considered to be of great potential but rarely exploited effectively, so studies such as the state of energy in Nepal have been more abundant mainly in the last decade. Parajuli (2011) illustrates the energy poverty in Nepal and argues that the definition of energy end-use equipment efficiency and minimum energy demand in Nepal is determined by the official residential sector ^[3]. Malla (2013) analyzed the patterns of household energy use situation in Nepal based on a LEAP framework with 13 analysis regions and three end uses ^[4].

Due to the evolving energy situation in Nepal and the latest advances in renewable energy technologies, Poudyal et al. (2019) reviewed the current energy production and consumption and identified the main factors contributing to the widening gap between energy supply and demand including delayed and overpriced hydropower projects, poor and inadequate energy infrastructure, transmission and distribution losses, energy theft, inadequate energy management, insufficient energy conservation ^[5]. The factors include delayed and overpriced hydropower projects, poor and inadequate energy infrastructure, transmission and distribution losses, energy theft, inadequate energy management, inadequate energy conservation, inefficient equipment, unsustainable energy pricing strategies and inadequate energy market regulation. Other underlying factors that exacerbate the energy crisis can be attributed to specific geographic and geopolitical issues, a strong dependence on energy imports, and the under-exploitation of large amounts of renewable energy.

Accordingly, the main reason for the huge gap between energy supply and demand in Nepal lies in hydropower projects and energy projects, thus, it is necessary to develop the electricity market in Nepal and the related analysis, and the need and the related potential of the electricity market development in Nepal have been suggested by the related scholars and experts. Nepal et al. (2011), using Nepal as an example, have made an overall assessment [6]. During the epidemic, the Nepalese government made economic recovery a top priority to recover the economy as quickly as possible. At the same time, the Nepalese government is also working to improve the business environment, improve investment regulations, strengthen the legal system, and improve the transparency of the judicial process to attract more foreign investment, and policy development and the investment environment related to the Nepalese electricity market have become topics. Walters et al. (2015) review a range of policy issues affecting the development and expansion of the decentralized electricity service market, from establishing an enabling policy environment to promoting finance, building human capacity, and integrating energy access with development plans [7]. The challenges in official policy-making in Nepal, the steps involved in privatization, and its relevance in the Nepalese context are discussed.

3 Current Status of Nepal's Electricity System

3.1 Energy Status in Nepal

Nepal is built on mountainous terrain with numerous rivers, huge drop-offs and abundant hydropower resources. Nepal's river system has a hydropower potential of about 83,000 MW. Currently, the utilization of hydropower is less than 1% of the hydropower potential. The total installed capacity of hydropower in Nepal is 650 MW, provided by 1,980 km of transmission and distribution lines, used by more than two million customers. The National Grid of Nepal, which owns 98% of the generation capacity and 99% of the electricity supply, represents the entire hydropower sector in Nepal.

Although Nepal's power sector said that annual electricity consumption has increased by 20 percent. Nepal is still facing a shortage of supply and demand despite its ability to provide electricity. Nepal's electrification rate (76%) is the same as other countries in the region, but there is a significant difference in the level of electrification between rural (72%) and urban (97%) areas. Nepal relies on hydropower for most of its electricity, but due to the lack of hydropower projects, the electricity supply is still very limited and many remote locations remain without electricity. Especially in winter, Nepal suffers from a significant shortage of electricity supply. Nepal currently has only 972 MW of available hydropower, but the maximum electricity consumption is 1,400 MW, which is between 7% and 9% every year [10].

Meanwhile, natural disasters in Nepal, such as droughts, floods, and earthquakes, have led to a vulnerable energy system, especially a severe shortage of electricity supply. The dry rains (winter and summer) characterize Nepal's hydroelectric power generation in a precarious state, with sparse rainfall and unbearable drought during the dry season between October and March each year, and abundant and flooding rains

during the rainy season from April to September. In the past, Nepal has experienced severe energy shortages, with water supplies running low during the winter dry period of the river when electricity is cut off for almost 18 hours a day. And Nepal is in a high mountainous fault zone, where the harsh geography leads to frequent earthquakes, and Nepal's electricity infrastructure has been damaged frequently in subsequent major earthquakes.

Nepal has enough energy reserves to cope with its energy shortage and even to export electricity abroad. However, these resources are underutilized. According to relevant data, Nepal Electricity Corporation received a total of 2,813.07 GWh from India in the fiscal year 2018-2019, an increase of 8.96% over the same period last year, and Nepal still needs to import about 30% of its electricity from India. Therefore, Nepal's electricity supply is unstable and affected by multiple factors such as natural and man-made factors such as geological disasters and infrastructure. According to Figure 1, it can be found that although Nepal has vast hydropower potential, it has not responded well to domestic demand, but continues to rely on power imports and has not completed the balance of power supply and demand ^[9].

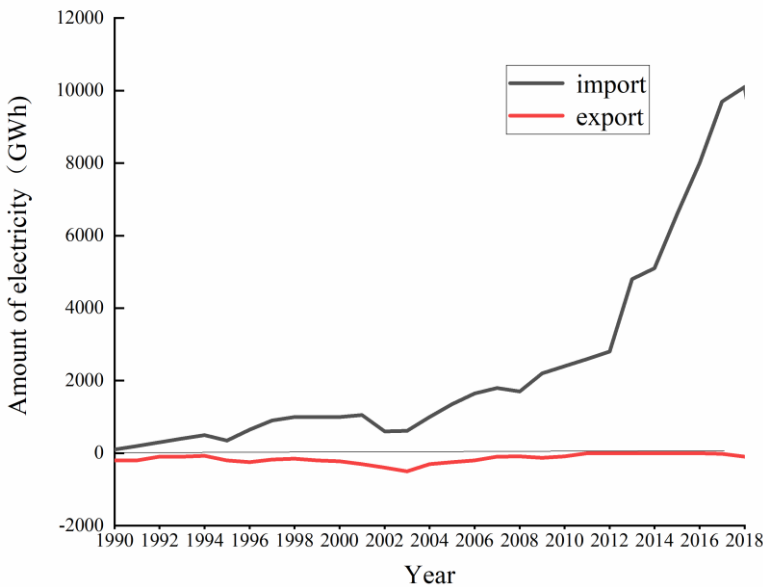


Fig. 1. Nepal's Electricity Import and Export Volume Change from 1990 to 2019

3.2 Current Status of Electricity Production

According to the official website of Nepal's Energy, Water Resources, and Irrigation Department, the latest information from Nepal's power development sector shows that by February 2022, Nepal has about 2013.1 MW of installed power capacity, which includes: 1,936.5 MW of hydropower, 53.4 MW of thermal power, 20.2 MW of solar power, and 3 MW of waste heat generation. The installed capacity has increased by 831.1 MW compared to FY 2018/2019, with 97.3% of the increase coming from the increase in installed hydropower capacity. The above shows that the installed capacity of Nepal's electricity and the amount of its growth in recent years are dependent on hydropower. The current status of the power supply in Nepal is shown in Figure 2.

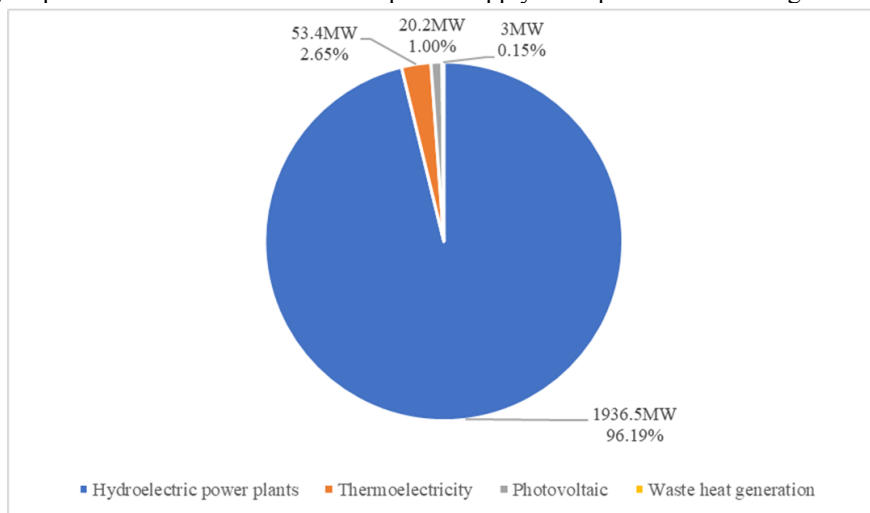


Fig. 2. Nepal 2022 Electricity Sources

Although Nepal is rich in renewable hydropower energy, the level of power generation and consumption is low and its utilization rate is worrisome. Some people in Nepal are not yet using electricity, while industrial enterprises are not developing as well as they should due to the lack of energy. Therefore, it is necessary to make full use of the available hydropower resources in Nepal for power generation. It is foreseeable that hydropower policy is an important prerequisite for developing rural electrification, meeting domestic energy needs, creating jobs, and developing industrial enterprises. The hydropower policy should reflect the policy priorities, such as developing multi-target projects to maximize water resources, etc.

3.3 Current Status of Electricity Delivery

Nepal's power system operates with high-voltage (132kV and 66kV) transmission, point-to-point transmission, and a non-closed grid structure. The central part of Nepal is largely covered by the electricity network, with the easternmost part of the grid being

the MECHI region and the western part being the MAHAKALI region. Nepal is already connected to India, but it is not yet connected to Tibet in China.

The Annual Report on Nepal's Electricity Development FY2020/2021 shows that the main grid voltage levels in Nepal are 66 kV, 132 kV, 220 kV, and 400 kV, with 132 kV, 220 kV, and 400 kV transmission lines under construction with lengths of 949 km, 1318 km, and 756 km, respectively. The completed, under construction, and planned grid projects in Nepal extend from the west-east to the north-south direction of Nepal.

The transmission grid loss ratio in Nepal has decreased from 20.45% in FY 2017/2018 to 17.18% in FY 2020/2021, and the system loss data of Nepal's grid from FY 2012 is shown in Figure 3^[10].

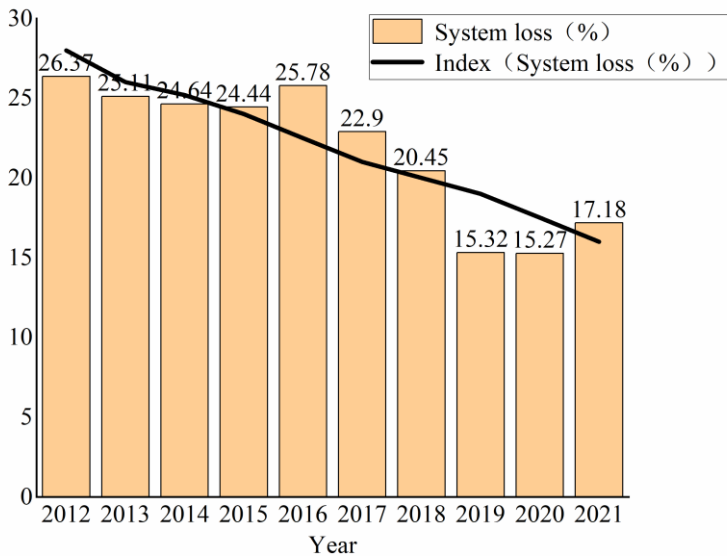


Fig. 3. Change in transmission grid losses in Nepal from 2012 to 2021

3.4 Current Status of Electricity Consumption

Nepal's maximum social electricity load for FY 2020/2021 is 1,482 MW, an increase of 5.26% from the previous fiscal year. Nepal's maximum electricity consumption has been on an upward trend over the past 10 years, with only a 12.5% decrease in FY 2018/2019, mainly due to flooding in the country, which stopped many electrical facilities from working, and the change in Nepal's maximum social electricity load value over the last 10 years is shown in Figure 4.

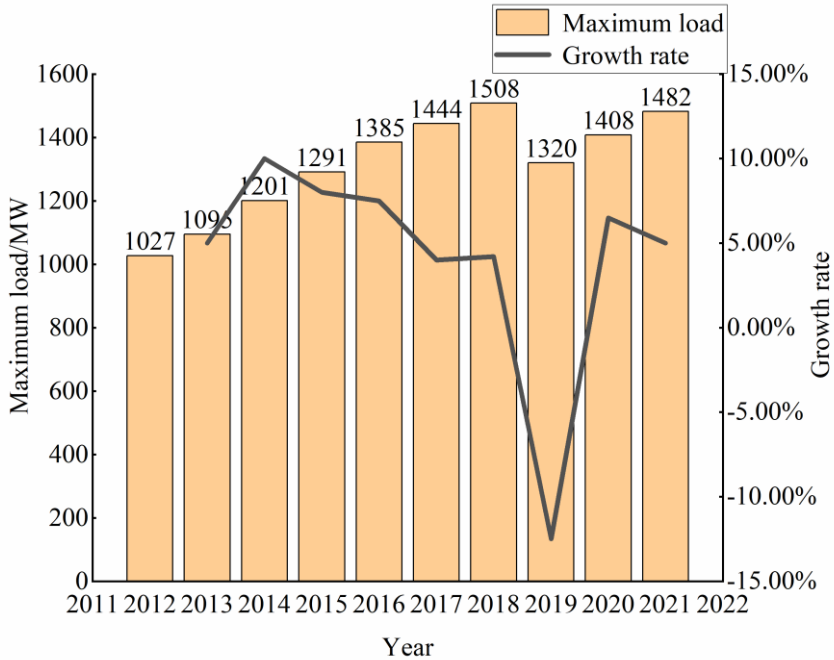


Fig. 4. Change of the highest social load of electricity consumption in Nepal from 2012 to 2022

4 Nepal's power investment environment and risk analysis

4.1 Analysis of the investment environment

4.1.1 Analysis of the political environment.

Nepal's weak rule of law environment, ethnic tensions, extreme poverty, and the impact of the catastrophic 2015 earthquake are key to the economic environment and the government's governance challenges. As a result, the government issued a common agenda in August 2021 covering various aspects including management of the New Coronary Pneumonia outbreak, strengthening governance, creating jobs to stimulate economic growth, maintaining national peace and security, and addressing foreign policy and border issues. However, with elections planned for late 2022 in Nepal, a parliamentary vulnerable coalition could trigger the distribution of power between parties, the political unrest that would continue to worsen due to opposition and possible disintegration within the coalition, and therefore a fragile decision-making capacity of the government, with weak leadership leading to a continued rise in popular discontent over the spread of the epidemic in the government. Coalition members, pursuing their different interests, are expected to impede progress on most key policy priorities.

In addition to the changing domestic political landscape, Nepal is also facing a new geopolitical crisis, with the US penetrating the country in an unprecedentedly aggressive manner, earmarking millions of dollars for Nepali media and a long-term strategic deployment to shape Nepali media, politicians, academics, think tanks and others. In late February 2022, Nepal adopted the US MCC agreement, claiming that it would not be a military ally of the US Indo-Pacific Strategy, but in fact, it has been 'forced' to become the center of a geopolitical maelstrom. At the same time, Nepal's decision to withdraw from the SPP in June this year has not yet been reciprocated by the Nepalese parliament, which suggests that US infiltration has forced Nepal into geopolitical competition. But the political environment in Nepal, which is at the center of a maelstrom of internal and external influences, is such that investment is subject to the constraints of inter-power competition and internal political shifts, and there is a risk that investment agreements will be canceled and projects set up after investment will be sidelined by the policy. But there is also a strong domestic desire for more foreign investment that is based on equality between the two sides, rather than ideological aggression in the name of 'investment'.

Nepal is a landlocked country between India and China, connected to the world through China and India, a strategic buffer zone between the two countries, and Nepal's relations with China and India are at the heart of its diplomacy. As Nepal is surrounded by India on three sides, its external communications are restricted by India. India is both Nepal's largest trading partner and has a strong influence on Nepalese politics, with millions of Nepalese working in India. The dispute over the redrawing of Nepal's boundaries in June 2020, which includes the disputed territories of Limpiyadhura, Lipulekh, and Kalapani bordering India, has led to a steady weakening of India-Nepal relations since 2015. The dispute has led to a weakening of India-Nepal relations since 2015 and a loosening of India's attempts to exert soft control over Nepal. Meanwhile, China and Nepal have signed more than 20 agreements and MoUs totaling over US\$2.4 billion in the areas of healthcare, agriculture, tourism, and infrastructure. Nepal would like to have closer economic and trade ties with China, but the competitiveness of Nepalese goods is low due to transport constraints, which has left Nepal with a huge bilateral trade deficit with China. Chinese investment is therefore welcome on this basis, provided that it is backed by a more stable political environment and projects with a better return on investment and their corresponding policies.

4.1.2 Economic Environment Analysis.

The 2019-20 financial year saw a global slowdown due to the ban on international flights, closure of border crossings, and stagnant tourism revenues. The embargo caused disruptions to supply chains, affecting production and construction activities, and a significant deterioration in domestic and foreign investor sentiment, which reduced fixed investment and thus underpinned government spending, with Nepal's GDP decreasing by 2.09% in the 2019-20 financial year compared to the previous year. National accounts figures released by Nepal's National Statistics Department indicate that Nepal has recovered in the 2020-21 financial year, with its real GDP increasing by 4.0% compared to the previous year, after excluding price factors, and the GDP decline

index increasing by 4.8% compared to the same period last year, and further improvements are expected in Nepal's economy.

Nepal's natural resources are hydroelectricity, which has the potential to develop about 42,000 megawatts of energy for commercial development. In the field of Nepal's foreign trade, according to the International Trade Centre (ITC), India (68.7%) and the United States (10.3%) are Nepal's main exporters; India accounts for 63.1%, China 15.7%, and the United States 1.3%. Therefore, there is still a lot of room for Nepal's hydropower development potential and therefore the government has made more planning and investment in this area. When the cooperation projects and investments between the two sides are finalized, Nepal's domestic demand and electricity exports will be greatly increased.

Nepal is open to foreign investment in many areas and the government has enacted progressive policies to facilitate investors in all aspects and has established the Nepal Industrial Authority and the Nepal Investment Commission. To attract foreign investment and develop key national projects, the government has formulated the Foreign Investment Policy 2020 to attract more foreign investors to Nepal and to invest in various sectors to boost the local industry and economy. Under the guidance of China's "One Belt, One Road" policy, Nepal's favorable investment environment will help attract more Chinese companies to invest in Nepal, strengthen the friendship and cooperation between China and Nepal, and promote Nepal's economic development.

4.1.3 Analysis of the investment environment in the power sector.

Most of Nepal's electricity relies on hydropower, but due to the lack of hydropower projects, the supply of electricity is still very limited and many remote places are still without electricity. Particularly in winter, Nepal experiences a significant shortage of electricity supply. Nepal currently has only 972 MW of available hydro energy, but with maximum electricity consumption of 1,400 MW, which is between 7-9% per year, Nepal faces a severe energy deficit with only about 65% of the population having access to electricity. In addition, the Nepalese government is preparing to upgrade from underdeveloped to developing country status by 2020 and to become a 'middle-income country' by 2030. The total amount of electricity that Nepal Power received from India in the 2019/20 financial year was 1,729 GWh, a decrease of 38.55% compared to the same period last year. Nepal Power generated 39.03%, 38.64%, 22.33%, and India Power's generation respectively.

In 2018, the Government of Nepal released a white paper on energy, water resources, and irrigation, cutting the share of pumped storage-type projects in the total generation portfolio to 30 to 35 percent. In the most recent cabinet resolution, pumped storage type projects have been reduced to 20-25% of all electricity generation in Nepal, and the importance of more storage type projects has long been felt as the country must import electricity during the dry season, increasing Nepal's vulnerability in terms of energy security. Since late March, India has failed to produce enough electricity due to the Russo-Ukrainian war, so there is a clear need for energy storage-type projects in the country. While Nepal has been exporting electricity during the rainy season, it has to import it during the dry season. Due to falling river levels, Nepal is unable to produce enough electricity during the winter months, so it has to rely on

supplies from India to meet the country's electricity needs, importing about a quarter of the country's electricity consumption from India. Therefore, Nepal needs storage or peak run-off-type projects to ensure energy security. However, domestic and international investors are not attracted to hydropower projects in Nepal due to the high cost of such projects.

4.2 Investment risk analysis

4.2.1 Political risks.

(i) Dramatic changes in the international situation and excessive political involvement in the energy market

The global epidemic of Newcastle pneumonia has exacerbated the economic and financial crisis in less developed countries, where the sustainability of economic development is already weak, and the lack of effective government management tools has further exacerbated the potential harm of the crisis. As the global economy gradually returns to normal, international factors such as the Russo-Ukrainian war have triggered knock-on effects such as rising prices, which have had a significant impact on third world countries, particularly in the slower developing parts of the world. Changes in the international situation, such as the New Crown epidemic, the Russian-Ukrainian war, and geopolitics, are all multifaceted influences that can create uncertainty in the investment environment. Particularly when there is a succession of crises, the changing international situation can bring about a more pronounced international supply chain exercise, making trade between countries subject to obvious political constraints. At the same time, Nepal's energy entry projects and trade agreements, such as electricity, are constrained by countries such as India, for example, in 2014, the process of negotiating hydropower plans between Nepal and India led Nepal to believe that even its hydro-power development had to be negotiated with India. On more than one occasion, India has warned neighboring countries about China's Belt and Road Initiative, saying that "there is no market for Chinese investment in India" and that "Chinese projects will be boycotted". And so on. Due to the excessive political involvement in the energy market, Chinese investors need to be wary of third parties with an interest in Nepal's hydro-power resources and projects.

(ii) Nepal's domestic political environment is highly volatile

Nepal has many parties and complex political forces. Frequent changes in government are a disadvantage to hydropower investment development, and it is easy for a subsequent government to negate or overturn the resolutions and signed documents of the previous government. For example, Nepal once canceled a contract with China Gezhouba for the Budhagandaki hydropower project when Kamal Thapa, then Nepal's Deputy Prime Minister and Energy Minister, deemed the agreement "illegal and unconventional". Despite the restart of the project in September 2018, the disadvantages of the Sino-Nepalese hydropower cooperation remain due to the change of government in Nepal. The planned Sino-Nepal hydropower cooperation has been hampered by changes in government personnel and strikes, and the level of political trust between the two sides needs to be improved. Nepal is a high investment risk country, so hydropower cooperation should be assessed with caution in the initial stages.

In addition to the high political risk, hydropower cooperation can also face some non-traditional security issues such as strikes and blockades under different cultures and philosophies. For example, residents of Nepal's Gorkha district, who were unhappy with the land issue for the construction of the Boudagandaki hydropower project, have carried out violent attacks against it; local people often go on strike and hold marches during Nepal's local elections, all of which have had an impact on the progress of the project. The political situation in Nepal is unstable, the security situation is more serious, and strikes and obstruction of workers still exist and tend to spread.

4.2.2 Economic risks.

Nepal is an underdeveloped economy with a small economy, a homogeneous economic structure, poorly developed markets, and vulnerability to the international trade environment, which carries certain market risks. Nepal's market approval procedures are cumbersome, foreign exchange controls are tight, the currency is at risk of continuous devaluation, and the business environment is harsh due to market instability and frequent worker strikes. But at the same time, Nepal's energy market is a huge business opportunity. The World Bank's *Doing Business 2020* report cites South Asia as the region with the highest percentage of economies implementing trade reforms. Trade reforms demonstrate the importance of cross-border cooperation in ensuring simplified customs clearance procedures, harmonization of compliance rules, and efficiency of border controls. Nepal, for example, has reduced import and export times by opening a new joint border crossing with India. But Nepal is overly dependent on imports from neighboring countries, and there is still too much third-party intervention and competition, among other things^[8].

However, it is also mentioned that the part that helps to promote the business environment lies in better access to credit, and Nepal has improved the access to credit information by expanding the coverage of credit bureau. At the same time, Nepal has introduced time-standard procedures for major court events and made contract enforcement easier through the adoption of a new civil code. The Nepali government also recognizes that existing bailout and recovery plans are not yet sufficient to lift the country out of the economic and social shock caused by the new coronavirus. Nepal's Finance Minister Sharma said that to safeguard public health, the government will continue to implement policies focused on improvement and recovery, which include controlling price increases, increasing capital expenditure, and accelerating fiscal activities.

4.2.3 Industry risks.

(i) A single approach to hydropower development and possible seasonal saturation of hydropower capacity

China is constrained in the construction of hydropower projects in the Nepal region, coupled with its large investment needs. As a result, hydropower generation in the Nepal region is mainly run-of-river type, which has weak seasonal regulation and generates more power during the rainy season and drops sharply during the dry season, thus the market capacity in Nepal may show a phase saturation. The dry season in

Nepal is from October to March, with very little precipitation; April to September is the rainy season, with abundant rainfall, which can provide sufficient water for hydropower. Therefore, during the rainy season, Nepal can supply sufficient electricity, while during the dry season, only about half of the electricity is available. As the Three Gorges Project continues to develop, its power generation capacity will be saturated in stages or even excessive during the rainy season in the future. The runoff power station, on the other hand, has little seasonal variation, making it difficult to guarantee the quality and stability of the power supply.

(ii) Energy resources are difficult to lend their application due to restrictions at gateways, financial and technical conditions

Nepal is rich in natural resources, but due to financial and technical reasons, resources are underdeveloped, limiting the development of domestic foreign trade; Nepal has a large number of development opportunities, both in terms of financial and technical many resources have not been fully utilized. Although Nepal shares a border with China in the north, cooperation and exchanges between the border areas of China and Nepal are hampered by the Himalayas. At the same time, Nepal has more than 50 airports, most of which are small, and only one international airport in the capital city of Kathmandu, with very limited air transport capacity. According to the Nepal Investment Environment and Risk Analysis Report, as of 2018, the total number of roads in Nepal is 29,639 km with low coverage. China's Zhangshu border crossing has been permanently closed since April 2015 due to the surrounding geological environment and geological disasters, which have seriously affected the economic and trade exchanges between China and Nepal. The Nepalese government decided in May 2022 that all land ports would be blocked from May 10 to May 13. Subsequently, the Ministry of Foreign Affairs of Nepal issued a memorandum on 14 July 2022 stating that consultations were held with China on the border issue that afternoon, and discussions were held on the border and boundary issues between the two sides. The Chinese side said that the joint inspection of the border between China and Nepal was of great importance and agreed to carry out the consultation mechanism under the existing mechanism. China and Nepal agreed to resume bilateral trade between Geelong/Jesuwar and to establish a related outbreak control mechanism by the agreement and guidelines for the prevention of the new coronavirus. To help the people of the Himalayan region of northern Nepal, the two countries decided to open a port at the Puran/Harissa port for the delivery of supplies and building materials to China. The unscheduled closure of the border crossing between China and Nepal will also have some impact on foreign investment, but as diplomatic relations between China and Nepal continue to progress and deepen, the restrictions on the ports may no longer be a problem.

In addition, despite the favorable environment and policies, Nepal has created for foreign investment, many foreign companies have been forced out due to poor infrastructure. Nepal is very rich in hydropower resources, but its internal power supply is very limited due to the lack of hydropower plants and the need to send power from multiple cross-border transmission lines from India every winter. Currently, there are no power transmission lines between China and Nepal, and many Chinese companies

investing in building plants in Nepal must provide their power generation facilities, which seriously affects local production and livelihoods.

5 Bilateral energy cooperation between Nepal and China

5.1 Advantages of cooperation between Nepal's hydropower development and China

(i) Nepal is endowed with unique hydropower resources

Nepal is rich in hydropower resources, with an estimated 83,000 MW of hydropower reserves, of which 43,000 MW is exploitable, but only 2% is being developed. 2010 saw the announcement of a 20-year hydropower plan by Nepal's energy department to increase Nepal's power generation capacity to 25,000 MW by 2030.

Nepal has more than 10 major hydropower projects with a total installed capacity of 1,000 megawatts. Among them, the Upper Tamaksi Hydropower Station is undertaken by China Hydropower Group International Engineering Co Ltd, with a total installed capacity of 450 MW. According to the Nepal Electricity Authority, the completed generation capacity to date is 943 MW, of which the planned capacity is 3,219 MW. The key projects of Nepal's capital program are currently funded by international relief organizations and bilateral aid countries such as the World Bank, the Asian Development Bank, China, India, Japan, and South Korea. Nepal is also encouraging foreign investment in Nepal's infrastructure projects through BOT and other forms^[10].

(ii) Nepal's energy needs are urgent and the prospects for hydropower development are bright

According to Nepal Electricity Corporation's financial report, in the first six months of 2022, the company's profit reached Rs12.12 billion. NEA's executive director, Kulman Gissin, said it could increase electricity sales in the first six months of this financial year by controlling leakage, increasing electricity exports to India and reducing electricity imports. NEA's first quarter revenue was Rs47.98 billion Rs 35.86 billion against the consumption of Rs 35.86 billion. The main revenues and expenses in the power sector are power sales and power purchases^[10].

Recently, a new figure was released by the Nepalese industry, which ranked Mainland China sixth in terms of total foreign investment in Nepal. The statistics show that mainland China will invest NPR 22.5 billion in Nepal in the 2020-21 financial year, a figure that represents 70 percent of the total investment during the current financial year, ranking first for the sixth consecutive year. Nepal's industry chief Buxar told Xinhua by phone that mainland China has been Nepal's top source of investment in recent years and hopes that China will invest in a wider range of regions.

(iii) Chinese hydropower projects have achieved fruitful results, created a good demonstration effect and promoted cooperation

At present, China-Nepal energy cooperation is mainly based on the South Asian Association for Regional Cooperation (SAARC) regional cooperation organization, with the China-Nepal Joint Working Group on Energy as a platform to build an energy silk road and an energetic community of destiny under the framework of "One Belt, One Road".

China has actively participated in energy cooperation projects in South Asia and has made significant contributions to energy security and development in South Asia. The China-Nepal Joint Statement in October 2019 proposed that China and Nepal will cooperate on power-related projects in the energy sector by the Memorandum of Understanding on Energy Cooperation. The two countries agreed to realize the China-Nepal power cooperation within one year and to take the China-Nepal power project as an important reference for the next step to promote practical cooperation in the power sector in China and Nepal. The China-Nepal Energy Cooperation Project is based on the Memorandum of Understanding on Energy Cooperation signed by the Ministry of Energy and Water Resources of China and Nepal, which sets out priority projects and development timelines for implementation around the development of hydropower, new energy and other power projects, the construction of transmission and distribution networks and interconnection of cross-border power grids.

In the context of the "One Belt, One Road", China adheres to the approach of energy diplomacy of goodwill and tolerance and works with Nepal to build an energy Silk Road and an energetic community of destiny. The two countries have agreed to accelerate the implementation of the Memorandum of Understanding on Cooperation under the Belt and Road Initiative, to strengthen ties in such areas as ports, roads, railways, aviation and communications, and to build a three-dimensional interconnection network in the Himalayan region, to help Nepal graduate from the least developed country status as soon as possible and achieve sustainable development by 2030.

5.2 China's strategy for hydropower development cooperation with Nepal

(i) Strengthen dialogue between the Chinese and Nepalese parties and enhance political mutual trust to lay the foundation for economic development cooperation

The strengthening of dialogue between the Chinese and Nepalese parties and the enhancement of political mutual trust between the two countries should start from the role of the Chinese and Nepalese leaders in diplomacy. Heads of state are the ultimate decision-makers in the formulation of a country's foreign policy and play a pivotal role in strengthening political trust between countries and consolidating the political foundation for international cooperation.

Secondly, unlike the strategic importance of summit diplomacy, China should build and utilize extensively a platform for dialogue between the various parties in China and Nepal. Through a platform of political party dialogue, the parties of each country can exchange experiences more transparently and directly, thus allowing for a broad-based strengthening of mutual understanding between the parties. The Minister of Foreign Affairs trip to Nepal in July 2022 to hold an official meeting with the leaders of Nepal's major political parties is a reflection of the progressive perspective of political party dialogue between China and Nepal. The extensive exchange and communication between Chinese and Nepalese political parties will provide more opportunities for political parties in both countries to deepen their understanding and lay a solid political foundation for economic and trade relations between China and Nepal.

Thirdly, the two ruling parties in China and Nepal should strengthen cooperation between each other. Socialism with Chinese characteristics has made world-renowned

achievements in economic development. The strengthening of the exchange of national development experiences between the two ruling parties of China and Nepal will help Nepal to determine its direction and development autonomously to its own needs and realities, thus opening up new and new areas for economic and trade cooperation between China and Nepal.

(ii) Strengthen the development of water storage power plants to ensure power consumption

Nepal's energy and power sector has repeatedly stressed the importance of water storage power plants in Nepal's electricity grid at annual energy summits and has actively introduced several countries to high-quality projects that are a national priority. The Nepalese government on the one hand lacks sufficient funds for independent development and construction, as reservoir power plants are generally large in terms of installed capacity and complex in terms of site selection and construction conditions. In addition, reservoir power stations have a certain regulatory effect on the power grid, which can fundamentally ease the contradiction between supply and demand during the dry season and achieve the purpose of power balancing, and the Nepalese government is trying to attract foreign investors to develop water storage type power plants, whose purchase price of electricity is also higher than that of run-of-river power stations, there are good reasons and opportunities for Chinese companies to focus on developing water storage power stations in the right time (e.g. 150-300 MW) to realize the principle of combining investment in the medium and long term, and the clustering of investment industries and regions.

(iii) Pay attention to the opportunities for cooperation with India and strive to realize cooperation between China, Nepal and India to establish cross-regional power cooperation

Cross-border power transmission lines between India and Nepal are of the type that neighboring countries transfer surplus and deficit. There is an electricity price differential between the two countries, which is highly complementary, and it is economically beneficial to send electricity across borders. For example, India and Nepal are connected by transmission lines, and each year India exports electricity to Nepal in winter and imports electricity from Nepal in summer^[11].

India, which borders Nepal, also suffers from severe energy deficits, and at its peak, it had a power deficit of 20 million kilowatts. Due to the rapid growth of energy-intensive industries in recent years, India will experience a period of power supply. The World Bank estimates that India's energy growth should exceed 10% to meet the demand for a GDP growth of more than 7% in 2015-2020^[8]. Nepal has abundant hydropower resources that are of interest to Indian companies. As domestic financing costs are higher in India than in China, this development model will gradually manifest itself as Chinese companies seek projects, Indian companies seek financing, and Chinese and Indian companies work together to develop Nepal's hydropower projects and ship them to India.

The dangers and workability of cooperation between China and India (or Nepal) cannot yet be precisely evaluated. In the current situation, bilateral electricity trade between Nepal and India has stagnated due to the lack of development capacity of Indian companies, and most of the Indian companies in Nepal's hydropower projects

have moved from being genuine investors to stockbrokers. So, although there are more opportunities for cooperation with Indian companies, in the near term, the relationship between Indian and Chinese companies remains predominantly competitive. Apart from being equity investors, the credibility and financial strength of Indian companies should ensure their financial viability and that power procurement in the Nepalese power sector is optimal.

With the growing power trade between Nepal and India and Nepal's growing need for a steady supply of electricity, the potential for cooperation with Indian companies is growing and Chinese companies can plan and seize the opportunity. China's approach to hydropower projects in Nepal should be one of orderly and modest development while focusing on the opportunities and risks of cooperation with Indian companies in large hydropower projects in Nepal.

(iv) Increase market research and actively respond to various risks

China-Nepal power cooperation should study the main measures and plans for cooperation in the near, medium and long term from multiple perspectives, such as resource allocation, capital, industry, technology and talents; make full use of Nepal's current master plan and various special plans to research and analyze key projects for cooperation, and further clarify the depth of pre-projects, technical and commercial conditions, investment returns and risk evaluation, etc. (ii) To further define the "priority projects", "active projects" and "possible follow-up projects" to promote the orderly and effective Sino-Nepalese power cooperation.

(v) Focus on strategic planning first and strengthen the whole process of docking

Promote cooperation on international networks between China and Nepal, and combine Nepal's power grid construction plans with China's power investment plans. China should accumulate experience in existing power planning, design and consulting, take the initiative to cooperate with Nepalese government departments, international organizations and grid cooperation organizations, assist Nepal in formulating grid development and development plans, and actively participate in cooperation on power infrastructure projects, understand Nepal's power market and grid construction, and seize opportunities to enter the development phase of projects as soon as possible. At the same time, strengthen communication and docking with local governments, partners and relevant organizations to create favorable external conditions for the smooth implementation of China-Nepal power projects. Strengthen the interface of planning and participate in the formulation of Nepal's power grid project, which includes network connectivity, technical specifications, investment and financing methods, progress and transactions. By establishing good cooperation with the Nepalese government and local partners, provide policy support to Chinese investment companies in various areas such as diplomacy, taxation and land use, thereby enhancing their economic efficiency.

6 Conclusion

The lack of electricity is currently one of the biggest issues the South Asian region is dealing with, and China may use its "super grid" to further deepen its power coopera-

tion with South Asian nations. To jointly promote the establishment and sound development of Nepal's electricity market, China and Nepal will collaborate on hydropower investment in accordance with the "enterprise-centric, market-oriented, and internationally acceptable" strategy. For example, China Power Construction Group has built the Upper Tamaksi Project, the Upper Bodiksi Project, the Tana Lake Reservoir Project, the Meeramchi Reservoir Project, etc. The promotion of the national energy strategy of the two countries has won the support of the governments and people of both sides for the above projects. Thanks to the assistance of China and other countries, Nepal's hydropower projects under construction are expected to turn from an energy deficit to a surplus of electricity with the addition of 3,000 MW by 2020. China has provided invaluable support to Nepal's development and has provided timely, proactive, and generous assistance to Nepal, advancing the development of relations between the two countries.

The hydroelectricity and sustainable energy markets in Nepal provide enormous potential for growth for global investment. Long a major project of interest to the rest of the world, hydropower in Nepal has seen the importation of many of its well-known hydroelectric structures. China is currently worried about Nepal's hydropower expansion and wants to work with Nepal to balance the supply and demand of electricity. Chinese businesses will offer the required assistance as both sides businesses continue to expand their collaboration in the electricity industry. China maintains its goodwill and tolerance-based approach to energy diplomacy in the context of the "One Belt, One Road" initiative. To create an electric Silk Road and an energetic community of destiny, it is ready to collaborate with Nepal.

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