Cross-Border Electricity Trade: Opportunities and Challenges for Nepal

Prakash Gaudel
Assistant Manager, Environment and Social Studies Department, NEA

Abstract

Nepal, with abundant hydropower potential and situated in a geopolitically important place, has the opportunity for cross-border electricity trade. The paper argues that for Nepal, the trade of electricity with neighboring countries of India and China is of both strategic and financial importance. This is because, even if Nepal develops all the potential hydroelectricity and export to neighbors, the contribution of such export will also be insignificant to them where the installed capacity have already crossed hundreds of thousands megawatts. In such backdrops, the paper attempts to explore the major opportunities and challenges of cross-border trade of electricity for Nepal. The paper delves into Nepal's existing plans, policies and regarding which, the paper urges for serious consideration in formulating or implementing them. Presenting the current status of bilateral and multilateral agreements and institutional arrangements, the paper reinforces the fact that cross-border electricity trade is not an easy task. Nevertheless, with prioritization of fulfilling internal demands, it is high time for Nepal to address the existing challenges and grab the opportunities offered by cross-border electricity trade. For this, the paper entails for the development of national strategy in lieu of considering electricity as trade commodity only.

Key Words: hydropower, cross-border, transmission lines, electricity trade, regional cooperation.

1. Background

Nepal, one of the South Asian nations, is surrounded by two most populous nations, China in the North and India in the remaining directions. With expanding economies, there is a growing demand for electricity in South Asia as well as in China. To meet this energy demand, the electricity is currently being produced from different sources in the region. This is mainly guided by naturally available resources. For instance, India and China are rich in fossil fuels, mainly coal; whereas Nepal is not rich is fossil fuel but has abundant water resources. Therefore, the electricity production in India and China are dominated by thermal power plants (Table 1) which depend on supply of fossil fuels and that of Nepal is hydro-dominated. The table below depicts the current electricity generation by source types in Nepal and Nepal's immediate neighboring nations.

With rising population and speeding economies, there is a need of more reliable and sustained supply of electricity. Nepal, as locked between the two giant nations, has the opportunities for cross-border electricity trade and the potentiality to change Nepal from land locked to electricity linked nation. This paper first discusses the existing cross-border trade of electricity and then analyze the

Table 1: Current Electricity Generation

S.No.	Energy Type	Source Type	Installed Capacity (MW)		
			Nepal[1] (June 30, 2018)	India[2] (May 31, 2018)	China[3] (2017)
1	Hydropower		1,006.78	49,889.23	341,190
2	Thermal	Diesel	53.41	837.63	1,106,040
		Coal		196,957.50	
		Gas		24,897.46	
3	Nuclear		-	6,780.00	35,820
4	Renewals	Solar	0.68	21,651.48	130,250
		Wind	-	34,046.00	163,670
		Geothermal	-	-	
5	Others	Biomass/Cogeneration		8,700.80	
		Waste to energy		138.30	
Total			1060.87	343,898.40	1,777,030

1 For detail, http://www.doed.gov.np/operating_projects_hydro.php
2 Ministry of Power, Government of India
3 https://chinaenergyportal.org/en/2017-electricity-other-energy-statistics-update-of-june-2018/

applicable national plans and policies. The cross-border agreements and institutional mechanisms for such trade are then discussed. With such backdrop, the paper then presents the opportunities and challenges of cross-border electricity trade for Nepal.

2. Nepal's Cross-Border Electricity Trade

Globally the cross-border electricity trade is gaining momentum. The governments and international organization are prioritizing such trade because of lowering costs, diversification of supply and tapping into low carbon or renewable energy sources (UN-ESCAP, 2018). However, trade of electricity requires strong cross- border interconnections of transmission lines and mutual cooperation among the nations.

At present, Nepal has interconnecting transmission lines with India only and there is no any trade of electricity with China. The cross-border electricity trade between Nepal and India is predominantly characterized by the import of electricity needs of isolated areas of both sides of border. All together over 20 cross-border bilateral power exchange facilities are operational at 11kV, 33kV and 132kV. The total electricity flow from cross-border transmission lines of capacity 33kV to 400kV is about 488MW (MoEWRI, 2018). Though Dhalekbar–Muzaffarpurcross-border transmission line is of 400kV capacity, it was being charged at 132kV since its operation in 2016 and recently upgraded to 220kV in July, 2018. These existing lines are currently being used mainly for importing electricity from India. Further, 11kV cross-border lines connects Jaljibe with Dharchula, Baitadi with Pithoragarh and Pipli with Dharchula.With existing cross-border transmission lines, trade of electricity with India has been mainly dominated by imports which is in increasing trend. The imports have increased by more than threefolds in a period of just 8 years. There is nominal volume of electricity being exported to India and the trend is decreasing (Table 2).

Table 2: Cross-border Electricity Trade with India

S.No.	Fiscal Year	Import (GWh)	Export (GWh)
1	2016/17	2175.04	2.69
2	2015/16	1777.68	3.15
3	2014/15	1369.89	3.17
4	2013/14	1070.47	3.40
5	2012/13	790.14	3.60
6	2011/12	746.07	4.12
7	2010/11	694.05	31.10
8	2009/10	638.68	75.07

Source: NEA (Annual Reports)

The maximum energy imported as per the Kosi and Mahakali Agreements total about 30MW (10MW from Kosi and a maximum of 20MW from Tanakpur for 70 million units). Ironically, the dry season imports is only about 17.5MW for these river treaties (MoEn, 2009). The remaining major share of import is from the power exchange agreements and commercial arrangements with power trading companies. Before entering into these agreements, it is worthwhile to first look into Nepal's plans and policies that dictate the cross-border electricity trade.

3. Nepal's Plan and Policy Regime

The concept of regional trade of electricity is not new for Nepal, at least in plan and policy documents. Initially, the trade of electricity between Nepal and India were guided by the bilateral agreements of Kosi and Gandak done in the 1950s. Nepal has also reflected the potentiality and possibility of cross-border hydroelectricity trade through its own plans and policies. The Hydropower Development Policy of 1992 has first envisaged to export hydroelectricity produced in excess to the national demand. The following subsection deals with the existing national policies and plans of hydropower and transmission line development in relation to cross-border electricity trade.

3.1 Hydropower Development Policy, 2001

In Nepal, hydroelectricity trade across the border is mainly guided by the Hydropower Development Policy of 2001. The policy envisages hydropower, from its objectives, to be developed as an exportable commodity. The policy has encouraged the export of electricity by considering the abundant hydropower generation capacity in the country. For such trade, the Policy has prescribed a strategy of bilateral or regional cooperation in the hydropower development sector. The Policy believes that the development of hydropower in Nepal will not only support the domestic economy but also the regional economy. Since the policy is focused on development, there is no mention of hydropower import.

3.2 Water Resources Strategy, 2002

The Water Resources Strategy (WRS) of 2002 is the first document of Nepal to acknowledge the principles of Integrated Water Resources management (IWRM). One of the specific objectives adopted by the WRS is 'to generate hydropower to satisfy national energy requirements and to allow for export of surplus energy'. As a long term purpose, in 25 years of time (by 2027), the WRS envisages the development of 22,000MW of hydroelectricity. As such large hydropower generation will meet the domestic energy demand, the Strategy aims at increasing revenues by exporting surplus energy of as much as 15,000MW to India and other neighboring countries.

3.3 Ten-year Hydroelectricity Development Plan, 2009

A taskforce for formulating the '10 year Hydroelectricity Development Plan' was formed by the Government of Nepal (GoN) on December 3, 2008. The taskforce came up with the final report in August, 2009 prescribing the generation of 10,000MW in ten years. This 10-year plan envisages the development of storage and non-storage projects in the ratio of 60:40, so that Nepal can export 3,000 to 5,000MW of electricity.

3.4 Twenty-year Hydroelectricity Development Plan, 2010

Without considering the essence and the findings of the final report of the task force for formulating 10 years plan of hydropower development, the GoN formulated another taskforce for formulation the '20 year Hydroelectricity Development Plan' on August 26, 2009. The task force was primarily given the responsibility of preparing a plan of generation 25,000MW in two decades. The task force submitted the report in April, 2010 which envisages the generation of total of 37,628MW of electricity including multipurpose projects of Pancheshwar, Karnali Chisapani and Sapta Koshi by 2029. If these three multipurpose projects are not conceived, the total generation is projected to be 20,354MW for the same period of 20 years. Since the generated electricity cannot be fully consumed in Nepal, the task force recommends for export to India. The plan has also considered the potentiality of cross-border transmission lines as well as the SAARC regional power grid and has recommended for at least one cross-border line from each major basin of Nepal.

3.5 National Energy Crisis Mitigation and Electricity Development Decade, 2016

A concept paper on mitigation of national energy crisis and electricity development decade was presented by the then Ministry of Energy in January, 2016. The plan is to import up to 930MW of electricity from India up to 2 years in order to fulfill the domestic demand of Nepal. In ten years of time (by 2026), generation of 10,000MW of electricity including 5,000MW from storage projects is anticipated. After fulfilling the internal demand, the plan suggest for the export of excess hydro-electricity. For this, the plan has foreseen the study and execution of cross-border transmission lines of 400kV capacity which includes a number of projects like New Butwal-Gorakhpur, Duhabi-Purniya, Kohalpur-Lucknow, Lamki-Bareli, Attaria-Bareli and Chilime Hub-Kerung.

Analyzing these national level plans of hydropower development, one can clearly visualize that there is no consideration of the previous plans and their implementation. The focus has always been kept on formulating fancy plans, one after another, emphasizing only on setting targets of thousands of megawatt of

Table 3: Fluctuating Targets of Hydropower Generation in Nepal

S.No.	Policy/Plan/Strategy	Target		Remarks
		Period	Capacity (MW)	
1.	Water Resources Strategy, 2002	2002-2027	22,000	including 15,000MW for export
2.	10 year Hydroelectricity Development Plan, 2009	2009-2020	10,000	including export of 3,000MW to 5,000MW
3.	20 year Hydroelectricity Development Plan, 2010	2010-2029	37,628	including 3 multipurpose project (Karnali Chisapani Pancheshwar & Saptakoshi)
4.	Electricity Development Decade, 2016	2016- 2026	10,000	later upgraded to 17,000MW in 7 years

Source: WECS, 2002; MoEn, 2009 and 2010

hydropower production (Table 3). However, in the lack of ownership and enforcement of serious plans by the authorities, the hydropower sector of Nepal is underdeveloped.

3.6 Transmission System Development Plan of Nepal, 2018

The Rastriya Prasaran Grid Company Limited (RPGCL), owned by GoN, has prepared Transmission System Development Plan in 2018. The plan has proposed the construction of 3,192km of 400kV capacity and 1,160km of 220kV capacity transmission lines. The plan also includes the six Nepal-India cross-border connection points in the Terai Region and two Nepal-China cross-border connection points in the Himalayan Region. These cross-border lines which will be capable of transmitting a total of 15,900MW of electricity (Table 4) are much same as proposed by the Electricity Development Decade, 2016.

Table 4: Proposed 400kV Cross-border Transmission Lines

S.N.	Cross-border TL Project	Length, km (up to border)	MW Flow
A. Nepal -India			
1	Dodhara-Bareli	58	3,000
2	Attariya-Bareli	30	700
3	Phulbari-Lucknow	44	2,600
4	Butwal-Gorakhpur	30	2,500
5	Inaruwa –Purnera	50	1,800
6.	Dhalkebar-Muzaffarpur	39	3,100
	Sub-total	251	13,700
B. Nepal-China			
1	Chilime-Kerung	14	1500
2	Upper Arun –Latse	23	700
	Sub-total	37	2,200
	Total (A+B)	**288**	**15,900**

Source: MoEWRI and RPGCL, 2018

The Transmission Plan was prepared as per the GoN latest targets of developing 15,000MW in 10 years and around 40,000MW by the year 2040. Prior to this, in 2015, Nepal Electricity Authority (NEA) has prepared a 'Transmission Master Plan of Nepal' from the year 2015 to 2035. Similarly, Joint Technical Team (JTT) of Nepal and India has formulated an 'Integrated Master Plan for Evacuation of Power from Nepal to India' up to the year 2035. However, the Plan of 2018 assumes that these prior plans were mainly targeted for electricity exports to India, and thus calls for updated master plan focusing more on internal consumption.

4. Cross-Border Agreements

The cross-border agreements on electricity trade can mainly be categorized into two types. The first includes the river project agreements which were primarily done for developing irrigation and flood control, and electricity has come out as a byproduct. The second one include power exchange/trade agreements which were done with the primary objective of exchange (or trade) of electricity. For Nepal, both types of agreements are predominantly bilateral and done with India only.

4.1 Bilateral Agreements

4.1.1River Project Agreements

There are some rivers, originating from China and flowing towards to Nepal. However, till date no agreement has been signed between Nepal and China for development of these rivers. On the other hand, Nepal has signed some bilateral agreement with India regarding the development of projects on transboundary rivers which flow from Nepal to India. Kosi Agreement, 1954 (amended 1966); Gandak Agreement, 1959 (amended 1964); and Mahakali Treaty, 1996 are the existing major bilateral agreements between Nepal and India. These agreements do have some

provisions for cross-border electricity exchange/trade.

As per Article 4 (ii) of the amended Kosi Agreement, Nepal is entitled to use up to 50% of the total hydroelectric power generated by any powerhouse situated within 10mile radius from the Koshi barrage on payment of certain tariff fixed by mutual understanding. This 50% electricity was materialized only in October 31, 1971 when the first two units of four turbines of Kataiya powerhouse, built in India on the irrigation canal drop, started generation (Pun, 2009) almost a decade after the completion of Koshi barrage in 1962. Though this supply of electricity is of no significance in comparison to the benefits to India in terms of irrigation and flood control, Upadhyay (2012) claims that the supply of electricity to Nepal is not a matter of agreement and negotiation but a matter of right- an entitlement. The Kataiya powerhouse was damaged by the Koshi flood of 2008 and as a result Nepal has been deprived of getting the said share of electricity on the agreed tariff.

Similarly, under the Gandak Agreement, a 15MW powerhouse was to be constructed by India in Nepalese territory using the canal drop Main Western Canal and a transmission line from the powerhouse in Nepal to Indian border. Though the powerhouse was commissioned in April 1979, the Gandak Agreement's 60% load factor for the powerhouse to be handed over to Nepal [Article 8 (iii)], forced Nepal to buy Gandak electricity from 1979 to 1981 (Pun, 2007).

Under the Mahakali Treaty (Article 2), Nepal obtained a supply of 70 million kWh (units), as against the earlier agreed figure of 20 million kWh, of electricity on a continuous basis annually, free of cost from Tanakpur Hydropower Plant located in India. The increase in energy from 20 million kWh to 70 million kWh is based on the calculation of the increment of power due to pondage on 2.9ha of land at elevation of 250m. Though not mentioned explicitly in the Treaty, the number that has been agreed was half of what increment the pondage contributes to the production of energy (Upadhyay, 2009).

4.1.2 Power Exchange Mechanisms

Though Kosi and Gandak agreements were done in 1950s, the first power exchange between Nepal and India materialized only in 1971 through the Kosi Power under the Kosi Agreement which was initially supplied to Biratnagar, Dharan and Rajbiraj (Pun, 2009). In due course of time, cross-border electricity exchange increased. By 1983, Nepal imported about 6MW of electricity from India for supply to border towns from 11 power exchange points and exported about 5MW from only Birgunj-Raxual point (Pun, 2009).

The tariff of such exchanged electricity across border is decided by Power Exchange Committee (PEC)[4]. Further, NEA concluded Power Sale Agreement on December 12, 2011 with Power Trade Corporation of India for importing 150MW power, mainly from Dhalkebar-Muzaffarpur 400kV cross-border transmission line. This Agreement is yet to be operationalized. Apart from this, NEA has been purchasing electricity through NTPC VidyutVyapar Nigam Limited of India.

4.1.3 Power Trade Agreements

As early in 1996, a Power Trade Agreement between Nepal and India was signed at secretary level. However, the agreement never came into implementation due tothe issue of parliamentary ratification (Pun, 2009). Almost after about two decades, Nepal and India signed another agreement "Indo-Nepal Electric Power Trade, Cross Border Transmission and Grid Connectivity Agreement" in October 21, 2014. This agreement is perceived to open new doors from cross-border electricity trade.

4.2 Multilateral Agreements

Even though the cross-border electricity trade of Nepal is dominated by bilateral arrangements as in the case of other South Asian nations, there are rooms for graduating from current bilateral arrangements to multilateral arrangements. For Nepal, the bilateral arrangements with China, the northern border is also strategically important.

There were efforts, in the past, for realizing the regional power grid project involving Bangladesh, Bhutan, India and Nepal. However due to India's negation, the project could not march forward (Pun, 2009). But, recently in 2017, with the visit of Prime Minister of Bangladesh to India, both the countries have agreed on conceiving of trilateral understanding between Bangladesh, Bhutan and India for the cooperation in the field of hydroelectric power[5]. Though this is a good start, the detachment of Nepal from this cooperation is quite questionable.

Beyond trilateral cooperation, at broader scale, the SAARC Energy Ring concept was first announced in 2004.

4. The PEC was formed in April 18, 1991 and is responsible for finalizing and periodically updating the matters related to exchange of power, including the tariff for the exchange of power between Nepal and India.
5. India-Bangladesh Joint Statement during the State Visit of Prime Minister of Bangladesh to India (April 8, 2017), Government of India, Ministry of External Affairs. Retrieved from: http://www.mea.gov.in

Unfortunately, there has no substantial progress towards the regional interconnectedness and cooperation (UN-ESCAP, 2018).Realizing the need and benefits of cross-border electricity trade, SAARC Framework Agreement for Energy Cooperation (Electricity) was signed by the member countries of the 18th SAARC Summit held in Kathmandu in November 2014. However, things have not moved forward as expected.

5. Opportunities

There are notable examples around the globe which depict the benefits of cross-border electricity trade. Such trade is accompanied by establishment of regional grid and powerful institutional arrangements. The Southern African Power Pool (SAPP) interconnecting 12 countries, provide an example of good practice in the regional energy cooperation (Rahman et al, 2011). Similarly, the other successful examples from the developing world includes West African Power Pool (WAPP) and Central American Power Market (Oseni and Pollitt, 2014). Similar opportunities for regional energy cooperation do exist in the South Asian regions. The opportunities for cross-border electricity trade specific to Nepal are discussed below.

5.1 Seasonal Variation

Steep topography and perennial rivers makes Nepal ideal for hydropower generation. However, Nepal's hydropower is characterized by seasonal fluctuations; which are indeed the ramification of the too little and too much water. The four months of June to September is characterized by the Monsoon which brings as much as 80% of the total precipitation in the country. Even in the pre-monsoon season, the high summer temperatures melts the snow and glaciers resulting in the increased discharge in the river. During this summer (pre-monsoon and monsoon) season, the hydropower generation of Nepal is maximum however the demand is not high.

On the contrary, in the same season, the electricity production in India goes down. This is mainly due to the fact that the major share of electricity generation in India is from coal. In the wet season the processes of mining, processing and transportation of coal are affected resulting in required availability of amount and efficiency of coal. Moreover, in the summer season, the electricity demand surges in India. This is mainly attributed by the increased use of cooling appliances and increased groundwater pumping for irrigation. Therefore, there seems perfect match for cross-border electricity trade between Nepal and India as the energy peak demand in winter and summer of Nepal and India are in contrast and can be used as complementary for exchange. This is the reason why Nepal proposed for the concept of 'Energy Banking' with India.

5.2 Cleaner and Climate Friendly Hydropower

Nepal's hydropower (untapped potential and current generation), is regarded as much cleaner sources of energy. On the opposite, both neighboring nations are heavily dependent on fossil fuels for thermal generation, the major greenhouse gas (GHG) emitters. Nevertheless, we should not deny the fact that both the nations are transforming themselves from the non-renewal sources towards renewals, as their international commitments. Furthermore, with the addition of hydro-based electricity imports, the flexibility of the grid will increase to adjust the intermittent supply for other renewals like solar and wind. Even for thermal and nuclear which take longer time to start or shut down, the hydropower have comparative advantage of quicker adjustment to the changing load.

Moreover, cross-border electricity trade need to be looked from a new perspectives of fulfilling Sustainable Development Goals as well as global climate commitments. Clean hydropower production from Nepal can offset at least some fossil fuel consumption and help reduce global emission of greenhouse gases. This is one of the major opportunities for cross-border hydro-electricity trade where both neighboring nations heavily depends on fossil fuel.

5.3 Strategic Opportunity for Nepal

There is a greater scope for Nepal regarding cross-border electricity trade from strategic point of view. As depicted in Table 1, the neighboring countries have already crossed hundreds of thousands of megawatts of electricity generation and therefore the amount of electricity to be exported from Nepal is insignificant from the financial perspectives. However, the geopolitical context and the security concerns of both neighbors provide ample strategic opportunities for Nepal to export its hydropower in the near future.

It is the high time to integrate the individual national energy markets of China, Nepal and India including other countries of South Asia Region. As Nepal has already been interconnected with the Indian electricity market, the integration with northern market is anticipated to increase the reliability and security of the energy market. Opening

of new cross-border transmission lines towards China is expected to end the monopoly of the Indian market, transforming the current bilateral trades of electricity to trilateral. The assurance from multiple buyers will also help Nepal to develop more hydropower through domestic or foreign investments.

6. Challenges

Despite having significant potential of techno-economically feasible hydropower, Nepal is not yet successful in meeting its own demand. On the contrary, policy regime for hydropower development in Nepal assumes that electricity may be exported to India and beyond. Top priority needs to be given to internal consumption and on increasing the per capita electricity consumption.

At the regional level, there had been talks on the energy cooperation in South Asia. The SAARC energy grid has also been included in the agendas of such talks for quite some time. However, no any generous progress has been made and the SAARC energy ring/grid still seems elusive (UN-ESCAP, 2018). Therefore, it is quite important to identify the challenges for such cooperation. For successful execution of cross-border electricity trade, there is the need to address the following challenges that prevails at the national and regional context.

6.1 Lack of Determined Plans and Institutions

From 2002 since the formulation of WRS to the Electricity Development Decade of 2016, different targets for hydropower generation were spelled out (Table 3). There is lack of coordination or acknowledgement among these plans.

In case of cross-border transmission lines, there are two major issues. The first issue is about the interlinkages and coordination of the recent plan of 2018 prepared by RPGCL with the previous plans of NEA and JTT. The question here is whether or not the 2018 transmission plan replaces previous plans. The second issue is about the ownership and implementation.

6.2 Regional Cooperation: Not an Easy Task

The cross-border trade with India may not be as easy as perceived or depicted by national plans and policies. The India's Guidelines on Cross-Border Trade of Electricity, 2016 is reported to have some contradictory clauses with the essence of SAARC Framework Agreement, 2014 and Indo-Nepal Power Trade Agreement, 2014 (Pun, 2018).

The World Bank's Ganges Strategic Basin Assessment Report (2014) has also highlighted that the potential for power trade among the basin countries is significant and simple to negotiate. However, as applied in the case of water resources, India is seemed to have its cross-border electricity cooperation to be fixed at bilateral levels with Nepal. Khadka and Adhikari (2005) has identified four major barriers to regional power market in the South Asian region, which includes policy barrier, technical barriers, institutional barriers and commercial or financial barriers, whereas, Malla (2005) has identified' post legacy of mistrust' among the south Asian countries as one of the major concerns for regional energy cooperation.

6.3 Electricity Trade: Does not necessarily lead to Prosperity

For the desired economic growth of any country, the (hydro)-electricity should be used as an input for internal consumption rather than just for exporting as a raw material. However, the national policy should not totally ignore the possibility of cross-border electricity trade where possible.

There are examples around the world which portray that selling hydropower, mainly by hydro-rich but economically weak nations, would not necessarily lead to prosperity. The Paraguay's hydropower export is one of the typical example where Paraguay alone is the main electricity exporter in South America but is still the second poorest nation in the region (Pun, 2008; Thanju and Canese, 2011). Similarly, Bhutan, a hydropower rich country like Nepal, exports major share of its hydroelectricity to India at nominal rates.[6] However in dry season, Bhutan needs to import the power back from India at higher rates (SARI/EI, 2016).

6.4 Storage Projects are not only Hydropower Projects

The cross-border hydroelectricity sale for Nepal is constantly and repeatedly being reflected in national plans and policies. These plans mainly rely on developing storage hydroelectric projects so that generated hydropower can be exported for financial returns. This concept is also equally strengthened by multilateral

6. Bhutan sells electricity as much cheaper price in the region. The electricity from the 336MW Chhukha HP is sold as the rate of Bhutanese Ngultrum (BTN) 2.25 per unit (revised from BTN 2 per unit from Jan. 2014); BTN 1.98 per unit (revised from BTN 1.75 per unit from Jan 2008) from 60MW Kurichhu HEP and BTN 1.98 per unit from 1020MW Tala HEP (SARI/EI, 2016).

agencies. The World Bank's Ganges Strategic Basin Assessment Report has emphasized that storage projects in Nepal would provide hydropower as the greatest benefits and there is little to do with flood control and water regulation in the downstream. Pun (2013) strongly portrayed this report as Indo-centric and suggested Nepal not to rush just because of significant power trade. But despite the multiple benefits of storage projects which surpass the benefits of electricity generation, the storage projects are being perceived as hydropower projects only. For example there is no consideration of downstream benefits from the proposed 1200MW Budhi Gandaki Storage Project. Decision makers of Nepal need to see Budhi Gandaki Project from multipurpose perspective which has potential to bring regional benefits (Upadhyay and Gaudel, 2014).

6.5 Increasing Socio-Environmental Concerns

The hydropower is considered as a much cleaner source of electricity. However hydro-projects are facing increasing concerns from the society and environment. Water diversion for hydropower generation can make downstream stretch completely dry which has adverse impact on the aquatic and terrestrial ecosystem as well as livelihood of the people. This is particularly applicable for run-of- river projects. For larger projects, construction of dams in the Himalayan Region includes complex as well as costly structures characterized by multiple problems. Besides different socio-economic impacts including involuntary displacement and loss of fertile land and many others, the creation of huge reservoirs on the lap of Himalayas, will also affect the microclimate of the region. Therefore clear scrutiny of projects not only from the economic or cross-border trade perspectives but also from the social and environmental perspective has to be done. However, the multiple national plans formulated one after another for the hydropower sale across the border seriously lack socio-environmental concerns.

7. Conclusion and Way Forward

The share of huge hydropower potential (about 83,000 MW) of Nepal, is merely less than five per cent of the current installed capacity of China and hardly one fourth of already installed capacity of India. So, the cross-border export of all feasible hydroelectricity from Nepal to these giants, will have hardly any nominal impact on their energy systems. By saying this, however, we cannot deny the fact that the energy trade of Nepal is of strategic importance. It is, therefore, necessary for the policy makers of Nepal to deal with this cross-border trade from strategic point of view and deal diplomatically with the neighboring nations.

For this, Nepal needs to formulate its own national and economic strategy related to cross-border electricity trade. Moreover, the environmental and social consequences of hydropower are on higher sides. Therefore, Nepal has to take care of optimum harnessing of rivers for hydropower production with prioritization of the domestic consumption. Realizing the need of trilateral and regional cooperation, Nepal should immediately attempt for executing cross-border transmission lines with China as well as take initiatives in implementing the SAARC Framework Agreement and the Power Trade Agreement with India.

References:

Khadka, P.R. and Adhikari, P. 2005. Regional Power Trading. In: *Proceedings of 6th International Conference on Development of Hydropower- A major Source of Renewable Energy*. Organized by International Association of Electricity Generation, Transmission and Distribution (Afro-Asian Region), Nepal Electricity Authority and Central Board of Irrigation and Power, India. June 7-9, Kathmandu. pp. I74-I83.

Malla, S.K. 2005. Regional Energy Cooperation in South Asia-Nepal Perspective; *6th International Conference on Development of Hydropower -A Major Source of Renewable Energy-Proceedings*, Vol. I, pp. I37- I53

MoEn, 2009. *The Taskforce for Formulating the 10 Year Hydroelectricity Development Plan-2065: Main Report* (Nepali Version), Ministry of Energy, Kathmandu, Nepal.

MoEn, 2010. *The Taskforce for Formulating the 20 Year Hydroelectricity Development Plan-2066 Report* (Nepali Version), Ministry of Energy, Kathmandu, Nepal.

MoEWRI, 2018. *White Paper on Present Status and Future directions of Energy, Water Resources and Irrigation Sector*, presented by Minister for Energy, Water Resources and Irrigation (Nepali Version), Ministry of Energy, Water Resources and Irrigation, Kathmandu.

MoEWRI and RPGCL, 2018. *Transmission System Development Plan of Nepal.* Ministry of Energy, Water Resources and Irrigation; and Rastriya Prasaran Grid Company Limited, Kathmandu.

NEA, 2017. *A Year in Review -Fiscal Year 2016/2017*. Nepal Electricity Authority, Kathmandu.

Oseni, M.O. and Pollitt, M.G. 2014. *Institutional Arrangements for the Promotion of Regional Integration of Electricity Markets-International Experience*. The World Bank.

Pun, S.B. 2018. Reflections on SAARC Framework Agreement for Energy Cooperation (Electricity) Vis-à-vis India's 'Guidelines on Cross Border Trade of Electricity'. In: *Hydro Nepal-Journal of Water, Energy and Environment*, Issue 22, Media for Energy Nepal, Kathmandu, pp. 1-4.

Pun, S.B. 2013. World Bank's 2012 Ganges Strategic Basin Assessment- A View from Nepal. In: *Hydro Nepal-Journal of Water, Energy and Environment*, Issue 12, Media for Energy Nepal, Kathmandu, pp. 6-12.

Pun, S.B. 2009. Power Trading. In: *The Nepal-India Water Relationship: Challenges* (eds. D.N. Dhungel and S.B. Pun); Springer Science and Business Media B.V.; pp. 153-196.

Pun, S.B. 2008. Paraguay, Bhutan and Nepal: Landlocked but Hydropower Rich-Cases of the Lame Duck, Flying Goose and Sitting Duck! In: *HydroNepal-Journal of Water, Energy and Environment*, Issue 3, Media for Energy Nepal, Kathmandu, pp. 9-13.

Pun, S.B. 2007. Whither Indo-Nepal Water Resources? Part III- Issues and Episodes to Reflect on Gandak River: Indo-Nepal Gandak Treaty, Amendment and Gandak Master Plan Study. *Vidyut*, Year 18, No.1: pp. 1-11.

Rahman, S.H.; Wijayathunga, P.D.C.; Gunatilake, H. and Fernando, P.N. 2011. *Energy Trade in South Asia-Opportunities and Challenges*, Asian Development Bank.

SARI/EI, 2016. *Impact of Cross-Border Electricity Trade on Bhutan (Country Series)*, Working Paper, South Asia Regional Initiative for Energy integration.

Thanju, J.P. and Canese, R. 2011. Lessons from Hydropower Rich Paraguay. In: *Hydro Nepal-Journal of Water, Energy and Environment*, Issue 9, Media for Energy Nepal, Kathmandu, pp. 7-11.

UN-ESCAP, 2018. *Integration South Asia's Power Grid for a Sustainable and Low Carbon Future*. United Nations' Economic and Social Commission for the Asia and the Pacific.

Upadhyay, S.N. 2012. *International Watercourses Law and A Perspective on Nepal-India Cooperation*. Ekta Books, Kathmandu.

Upadhyay, S. N. 2009. The Mahakali Treaty: View from the Negotiating Table. In: *Mahakali Treaty-Pros and Cons for Nepal* (eds. A.P. Srestha and P. Adhikari), Sangam Institute, Kathmandu, pp. 101-144.

Upadhyay, S.N. and Gaudel, P. 2014. Cross-border Downstream Benefit Sharing in Reservoir Type Hydropower Projects: Case of Budhi Gandaki Storage Project in Nepal. In: *Hydro Nepal-Journal of Water, Energy and Environment*, Issue No. 14 (January, 2014), Media for Energy Nepal, Kathmandu, pp.59-64.

WB, 2014. *Ganges Strategic Basin Assessment: A Discussion of Regional Opportunities and Risks*. World Bank South Asia Regional Report.

WECS, 2002. *Water Resources Strategy*. Water and Energy Commission Secretariat, Kathmandu.