

# Nepal's Water Resource Development Challenges

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## ABSTRACT

*Water resources of Nepal represent one of its most valuable renewable natural assets. This paper examines the challenges and opportunities inherent in the development of Nepal's water resources, with a specific focus on the cooperation between Nepal and India. Additionally, it delves into the water resource development policy from the perspective of People's Multiparty Democracy (PMPD). Harnessing Nepal's water resources optimally, particularly through hydroelectricity, irrigation, and floodwater storage, holds immense potential for bolstering the country's economic growth and fostering socio-economic advancement in the broader South Asian region. However, issues surrounding water resources have emerged as a significant point of contention between Nepal and India. This paper critically evaluates Nepal's bilateral agreements on water resources, particularly those with India, and explores comparative practices within similar geographic contexts. It identifies parallels between the global understanding of integrated water resources management policy and the principles outlined in PMPD policy.*

## Introduction

Water is a vital natural resource that serves various purposes, including domestic uses such as drinking and bathing, irrigation, agriculture, fisheries, hydroelectricity generation, industrial processes like cooling and waste disposal, navigation, and ecosystem and environmental conservation. Consumptive water use refers to water that is consumed by humans or livestock, incorporated into products or crops, evaporated, transpired, or otherwise removed from the immediate water environment, such as a water body, surface, or groundwater source. The uneven distribution of fresh water in space and time creates physical constraints, amplified by overuse, pollution, and poor management. This limits access to clean water for millions of people, adversely impacting their health, food security, livelihoods, and well-being, especially in developing countries.

United Nations World Water Development Report of 2015 predicts a 40% global freshwater shortage by 2030, with the most severe impacts on developing nations. Despite more than two-thirds of fresh water being used for irrigation, many families still experience food insecurity. The challenges are worsened by the transboundary nature of rivers and aquifers (Shrestha & Silwal, 2017). Since 1997, the World Water Council has organized the World Water Forums (World Water Council, 2024) to address pressing water-related issues and challenges with themes such as "Vision for Water, Life and the Environment" in 1997, "From Vision to Action" in 2000, "A Forum with a Difference" in 2003, "Local Actions for a Global Challenge" in 2006, "Bridging Divides for Water" in 2009, "Solutions for Water" in 2012, "Water for Our Future" in 2015, "Sharing Water" in 2018, "Water Security for Peace and Development" in 2022, and "Water for Shared Prosperity" in 2024

(World Water Council, 1997-2024). Overall, the themes of the World Water Forums reflect principles of inclusion, grassroots participation, democratic governance, and a commitment to addressing the needs of all stakeholders through cooperative and equitable approaches. They consistently emphasize the importance of integrated water resources management, the need for cooperation across boundaries, the role of technology and innovation, and the necessity of political commitment to address global water challenges. Despite such international initiatives, the Indian subcontinent lags regional cooperation on water resources development on shared rivers.

India is the most populous and rapidly developing country in the world. The total water demand of India for irrigation, domestic, and industrial uses is about 680 billion cubic meters, of which 44% is sourced from groundwater. India's water demand projection for 2025 is 833 billion cubic meters, including 43% groundwater, and for 2050, the

demand will reach 900 billion cubic meters, including 47% groundwater (Amarasinghe et al., 2007). By 2030, the total electricity demand in India, including captive demand (excluding T&D losses), is projected to be 2,060–2,699 TWh, which is double the 1,310 TWh of 2021–22. Projection for 2037 suggests a rise in ex-bus electricity requirement to 2,936–3,175 TWh, with the Central Electricity Authority's (CEA, India) projection being 3,095 TWh (Pachouri et al., 2023). The industrial sector of India is expected to be the biggest contributor (~40 percent) to the increasing electricity demand, followed by the residential and commercial sectors.

China, Nepal, India, Bhutan, and Bangladesh share the Ganga and Brahmaputra basins. The Indus River flows across China, Afghanistan, Pakistan, and India. All rivers from Nepal are tributaries of the Ganga River. The main rivers of Nepal are the Karnali in the west, the Gandaki in the central region, and the Koshi in the east (see Figure 1).

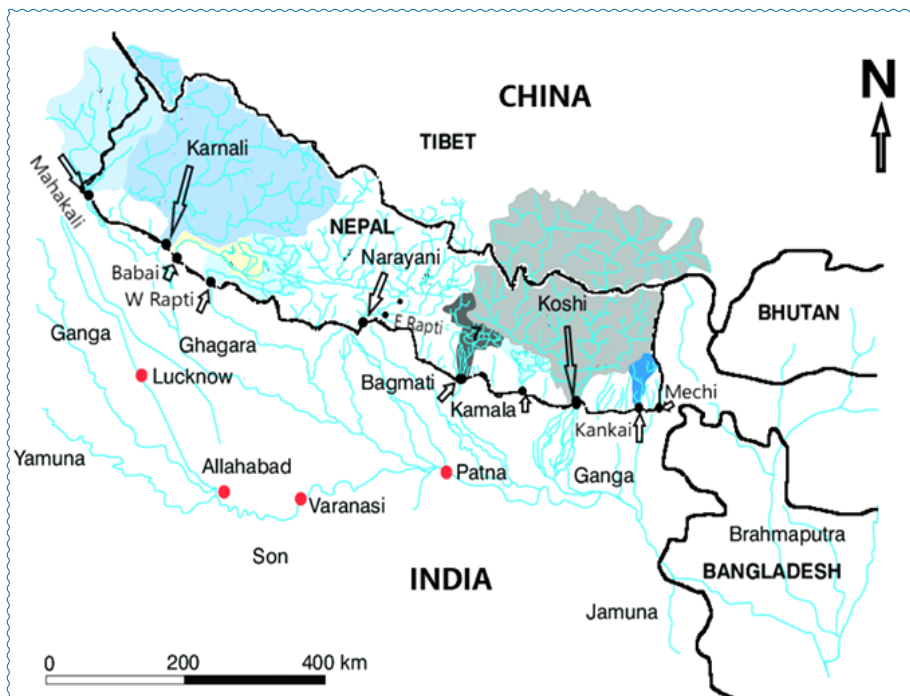


Figure 1: Main rivers of Nepal and catchment area

Along with parts of their watershed extending into Tibet in China and India, these rivers cover approximately 78% of Nepal's mountainous region and about 70% of its total area. The Mahakali River, forms Nepal's western border with India, drains about 3.6% of the country's area. The rivers of Nepal are categorized as snow-fed Himalayan rivers, non-snow-fed Mahabharat rivers, and seasonal rain-fed Churia rivers. The Koshi, Gandaki, Karnali, Mahakali, and all their snow-fed tributaries are first-order rivers. The second-order rivers, such as the Babai, Rapti, Bagmati, Kamala, Kankai, and Mechi, originate below the snowline, and the third-order rivers, which are ephemeral, originate in the Churia range. Nepal has little plain land and arable land for irrigation due to its mountainous terrain and steep slopes over short distances. However, because of its unique topography, Nepal has significant hydropower potential.

The water resources of Nepal are naturally shared with India and, through India, with Bangladesh. Common issues arising include degraded watersheds and water quality, increasing water demand for food security, and the impact of climate change on water availability. The sharing of benefits is a contentious issue in agreements between Nepal and India, Pakistan and India, and India and Bangladesh. In general, the constraints to water resources development are natural challenges and geopolitical hurdles. Nepal has little plain and arable land, whereas downstream India possesses vast areas of the Gangetic plain. In addition to climate variability (seasonal and diurnal temperature fluctuations), the background knowledge and environment, in other words, up-to-date knowledge of the subjects, guide the direction and processes in research (Bhusal, 2022). In this context, this paper aims to assess the situation of water availability and utilization in Nepal, with a special focus on the issues of water resources development cooperation with India. This is important because regional cooperation on Himalayan water resources has not been fully established.

## **Methodology**

The interaction between water and society can be assessed through the concept of political ecology and the hydro-social cycle. Water flow interventions are political and debatable by nature since they are influenced by power dynamics and are likely to benefit some groups while marginalizing others (Woude, 2016). The ability to use or benefit from resources is referred to as access, which can sometimes be attained by unethical or unlawful means (Ribot & Peluso, 2003). Thoughts are also influenced by existing situations. The methodology adheres to situational analysis (Clarke, 2005). Water resources policies and water governance are guided by political philosophies (Shrestha & Silwal, 2017). This paper examines how the People's Multiparty Democracy (PMPD) viewed water resources in its program (Bhandari, 1993). The then contemporary policies are outlined in the programs presented at the Fifth National General Convention of the CPN (UML). PMPD vehemently advocates a pro-Nepal foreign policy that promotes the sustainable development of water resources.

PMPD addresses energy and water resources in its policies. It recognizes access to water as a human right and prioritizes national interests, human rights, and a balanced, dignified foreign policy (Bhandari, 1993). Madan Bhandari's rhetorical analysis covering topics such as monarchy, constitution, parliamentary elections, and the Tanakpur Treaty had a profound impact on shaping the Nepali perspective (Karki, 2023). Background factors like the collapse of communist regimes in the Soviet Union, the failure of Nepal's autocratic kingship for overall development, and India's dominant water resources agreements between the two countries stirred these stances. Bhandari stood firmly against the unilateral Tanakpur agreement on the Mahakali River imposed by India and consented to by the then Nepali Congress government. The agreement undermined Nepal's sovereignty and

national interests. On 6 April 1993, Bhandari, serving as General Secretary of the Communist Party of Nepal (UML) and as a member of parliament, asserted his party's position on the infamous Tanakpur Treaty in the House of Representatives. He demanded ratification and approval by a two-thirds majority of the House, as stipulated in Article 126 (3) of Nepal's 1990 Constitution (GoN, 1990). This demand was to nullify the Tanakpur agreement and adopt an equitable benefit-sharing agreement on the border river. PMPD adopts policies of safeguarding the unalienable sovereign rights of the Nepali people over water resources.

PMPD, an innovative political philosophy, is highly appreciated in South Asia and beyond (Dhakal, 2023). The principle stands on the democratization of traditional autocratic communism for social welfare. Bhandari discussed his policy on energy and water resources as below:

The energy policy shall be formed by linking it to agricultural and industrial development, promoting balanced regional prosperity, and prioritizing energy export and environmental conservation. Electric power shall be established as the main source of energy for daily use by people and industries in the country. The policy aims to make electricity readily available at a low cost in rural areas. The government shall play the role of promoter for energy development, initiating a tradition of recognizing the local people's inalienable rights over forests, water resources, air, and solar energy. A policy shall be adopted to ensure the participation of local people in the development of these resources. The different agencies concerning energy shall operate in a unified manner. Emphasis shall be given to operating micro and small-scale hydroelectric projects under the ownership and active participation of local people. These projects shall be developed under government corporation

boards. Multipurpose projects of international importance shall also be managed by international boards. The policy of utilizing border rivers such as the Mechi and Mahakali shall be based on the principles of equality and partnership. Emphasis shall be placed on establishing a SAARC-level international power line system and including SAARC countries in it. Priority shall be given to executing energy preservation projects for the unified utility of water resources (for example, the Seti and Budhi Gandaki), multipurpose reservation projects (for example, the Karnali and Rapti), and projects for diverting large-volume rivers into smaller-volume rivers (for example, the Sunkoshi, Kamala, Kali Gandaki, Tinau, Bheri, and Babai). Since water resources are used in multi-dimensional activities like irrigation, industrialization, water transportation, daily use, and developmental foundations, policies shall be adopted to develop them harmoniously. Policies shall also be adopted to safeguard the inalienable sovereign rights of the Nepalese people over water resources (Bhandari, 1993).

This paper is primarily based on published data on water availability and utilization, as well as various policy documents on water resources development in Nepal. It collects and analyzes bilateral agreements on water resources, particularly those between Nepal (a landlocked country) and India since British colonial rule. In addition, relevant contemporary water resources policies—national, bilateral, and international agreements—were collected and studied. India's current water and energy policies, the water resources policies of South Africa and Lesotho (another landlocked country), and the Columbia River Treaty between the United States and Canada are also reviewed. Data on water resources and hydro energy potential in Nepal are

sourced from the Department of Hydrology and Meteorology (DHM), Government of Nepal, and its publications. Published stream flow data by the DHM are used to assess the total runoff in Nepal and the total volume of water entering India annually. A simple area-runoff relationship is used to assess runoff from ungauged locations. Current water requirements are determined based on per capita water use.

## Results and Discussion

### Renewable river waters of Nepal

Mean annual precipitation (rainfall and snowfall) over Nepal is about 1700 millimeters (ICIMOD, 1996). This amount is equivalent to approximately 250 billion cubic meters (BCM) of water falling over Nepal annually. Monsoon clouds from the

Indian Ocean contribute about 75-80% of the yearly precipitation over four months (June to September). A portion of the annual precipitation accumulates as ice in the Himalayas, some returns to the atmosphere through evaporation and evapotranspiration, some percolates into the ground, and the majority flows out of Nepal as surface runoff.

Nepal has vast renewable water resources, but its rivers exhibit irregular flow patterns (DHM, June 1988). Compared to non-snow-fed rivers, snow-fed rivers have a more consistent flow due to the melting of glaciers and snow areas. The mean monthly flows in cubic meters per second of major rivers are given in Table 1.

**Table 1: Available volume of water in major rivers of Nepal**

River	Area	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Year
	Km <sup>2</sup>	m3/8	m3/8	m3/8	m3/8	m3/8	n13/8	m3/8	m3/8	r113/8	m3/8	m3/8	m3/8	m3/8
River Basin	Km 2	m3/8	m3/8	m3/8	m3/8	m3/8	n13/8	m3/8	m3/8	r113/8	m3/8	m3/8	m3/8	m3/8
Mahakali river	12600	99.5	86.9	85.0	105	156	379	1097	1507	1097	396	183	123	443
Area within Nepal	5 317													
Area : Karnali-Mahakali	3811	22.7	18.5	15.1	11.8	15.7	71.6	265	308	291	117	44.0	27.3	101
Karnali river	43227	373	338	351	449	708	1532	3316	4404	3044	1330	637	450	1411
Babai river	3252	21.1	17.2	14.2	11.4	17.2	63.5	263	281	272	106	38.9	25.5	9
Area : Babai-Rapti	948	5.6	4.6	3.7	2.9	3.9	17.8	658	76.6	72.3	29	10.9	68	
West Rapti river	6215	33.7	27.4	22	16.7	13.2	112	360	463	426	177	69	40.3	
Area :Rapti-Narayani	4849	35.1	23.9	23.5	20.6	34.4	163	543	591	573	192	71.2	43.2	195
Narayani river	31726	358	269	292	355	579	1642	4295	5070	3469	1632	806	502	1607
Area :Narayani-E-Rapti	2327	288	23.8	21.5	24.1	35.9	102	295	366	231	124	59.3	38.2	117
East Rapti river	1175	158	13.2	11.7	11.11	148	42.4	139	132	154	64	30.1	20.0	58
Bagmati river	3681	25.4	22.9	20.8	22.6	428	290	729	694	457	135	69.0	36.4	216
Area : Ba m ati-Kama la	3013	208	16.7	17.1	185	35.0	237	597	568	374	152	56.5	298	177
Kam ala river	1786	12.2	10.7	10.3	12.5	22.0	97.7	245	240	166	69.1	29.9	17.1	78
Area : Ka ma la -Koshi	1896	12.9	11.4	10.9	13.3	23.4	104	260	255	176	73.3	31.7	182	83
Sapta Koshi	27863	364	315	318	424	705	1660	4110	4340	3460	1460	795	501	1538
Area :Koshi-Kankai	3462	33.5	27.9	24.9	32.6	56.5	153	434	345	324	142.1	70.4	44.9	141
Kankai Mai	1317	13.2	10.7	9.2	128	23.9	62.4	227	166	122	58.9	26.5	17.6	64
Area : Kankai Mechi	1316	12.7	10.6	9.5	12.4	21.5	580	165	131	123	54.0	268	17.0	53
Total	147161	1483	1255	1260	1555	2513	6326	17406	19994	14906	6363	3055	1958	6549
Million cubic meters per day		3985	3031	3371	4031	6731	17691	46621	53551	38641	17041	7911	5244	
Billion cubic meter per month		4.0	3.0	3.4	4.0	6.7	17.7	46.6	53.6	38.6	17.0	7.9	5.2	208

Source: From the new map- total area could be 147580 square kilometers (Unofficial calculation)

Melted waters from snow areas and glaciers contribute relatively constant flow in snow-fed rivers compared to non-snow-fed rivers. All the rivers originating in Nepal flow to the southern Tarai and ultimately into India. Table 1 shows the mean monthly runoff at Indo-Nepal border points and also contains the volume of available water in billion cubic meters (BCM) per month entering India, showing that a vast amount of water flows from Nepal to India.

The increasing temperature due to climate change poses a threat to the Himalayan solid water reservoirs of Nepal. Nearly 75% of the annual volume of water leaves the respective watershed from June to September (see Figure

2). Only one-quarter of the annual surface water is available for the remaining eight months. Figure 3 shows the monthly runoff percentage. The shape of the watershed area, main river lengths, and other factors affect flow patterns. Although the Koshi is the largest river, the annual peaks of the Narayani are higher than those of the Koshi (Figure 3). Figure 4 contains the annual hydrographs of some non-snow-fed rivers. In general, river flows follow a recession pattern exponentially (Figures 3 & 4). Average monsoon (June to September) flows of three major rivers are 8 to 12 times the dry season's (January to April) flows, whereas average monsoon flows in non-snow-fed rivers are 12 to 24 times or more than the dry season flows.

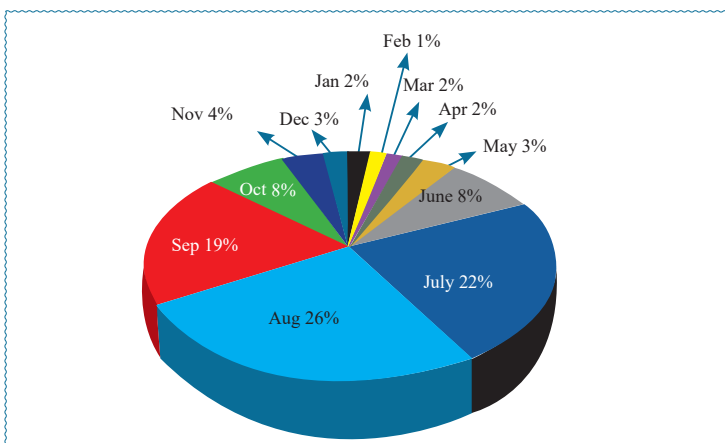


Figure 2: Monthly distribution of annual runoff in percent of total

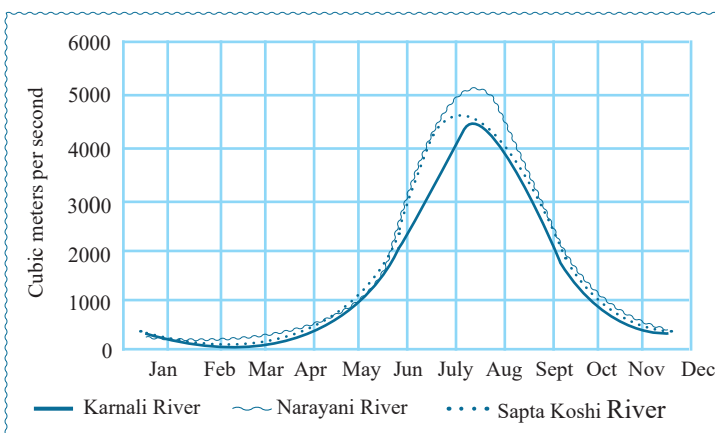


Figure 3: Annual hydrograph of Karnali, Narayani & Koshi river

The three major rivers—Karnali, Narayani (Gandak), and Koshi—drain about 70% of Nepal's area. These transboundary rivers also drain parts of Tibet. Every year, about 208 billion

cubic meters (BCM) of water flow out of Nepal as surface runoff. Approximately 145 BCM of this water, or 70% of the total, enters India through these three rivers.

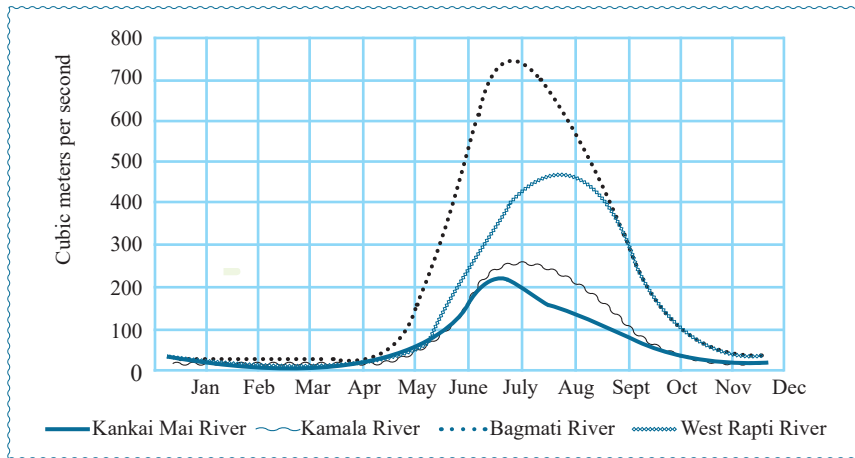


Figure 4: Annual hydrograph of non-snow fed rivers

The remaining volume flows into India from non-snow-fed rivers and ephemeral streams through the Siwalik and Tarai regions (Figure 4). About 150 billion cubic meters of water run off during the rainy season alone. The rivers flowing from Nepal contribute significantly to the flow of the Ganga, providing about 40% on average, while during lean periods, their contribution increases to up to 70%.

### Other water resources

The mountain area of Nepal is covered with snow and stored water. About 7,863 square kilometers of Nepal consist of snow-covered areas, which include glaciers and glacial lakes (Forest Research and Survey, Nov. 1990 - Jan. 1991). These snow-covered areas serve as Nepal's solid water reservoirs. There are 3,252 glaciers

covering an area of 5,323 square kilometers, with an estimated ice reserve of 481 billion cubic meters (BCM). The total number of lakes identified so far is 5,358, of which 2,712 lakes are below 500 meters in elevation, 419 lakes are between 500 and 3,000 meters, 116 lakes are between 3,000 and 4,000 meters, and 2,111 lakes are above 4,000 meters (NLCDC, 2021). The total volume of lake water, estimated from the lake surface area, is between 5 BCM and 8 BCM (Table 2) (Bhusal, 2019). Additionally, groundwater resources are mainly found in the main Tarai and the Inner Tarai valleys, such as Udayapur, Chitwan, Deukhuri, Dang, Surkhet, and the Kathmandu Valley. The volume of water available annually for groundwater extraction is estimated to be between 5.8 BCM and 12 BCM (Poudel, 2019).

Table 2: Water reserves as ice, groundwater, and lake water

Stored water reserves	BCM
Water stored as ice reserve in 5323	481
Volume of water stored in 5358 lakes	5 to 8
Groundwater extraction (annually)	5.8 to 12

Given its hilly terrain, Nepal offers a wealth of potential locations for storage projects. According to a preliminary assessment by the Ministry of Water Resources (MoWR), Nepal can store almost 128 billion cubic meters of water, of which 82 billion cubic meters may

be regulated (Table 3). If potential storage reservoirs are built, about 40 percent of the yearly runoff and 50 to 60 percent of the monsoon flow could be stored and released during the annual lean season (Bhusal, 2015).

**Table 3: Water storage potential of identified sites, Nepal**

Number of Sites	Dam height	Catchment km <sup>2</sup>	Storage capacity, million. m <sup>3</sup>		Submerged Area, km <sup>2</sup>
			Gross	Live	
9	144 m to 315 m	9111 to 54100	100310	66330	1394
10	85 m to 230 m	1190 to 16200	25570	13910	503
8	51 m to 140 m	126 to 30800	2824	2031	76
27	← Total →		1286704	82271	1973

Large reservoirs may not be Nepal's top priority because the country has only limited irrigable areas in the southern Tarai and river valleys. However, high dam reservoirs would be highly advantageous for water resource development and cooperation with India, Bangladesh, and other countries.

## Utilization of water resources in Nepal

### *Domestic use*

The total human population of Nepal is 29 million, with 66.17 percent living in urban municipalities and 33.83 percent living in rural municipalities. There are 6,666,937 households, of which 4,474,699 are in urban municipalities and 2,186,142 are in rural municipalities (National Statistics Office, 2023). The livestock population is 7.5 million, but the number exceeds 21 million when including goats, sheep, and pigs (Department of Livestock Services, 2022). At a rate of 150 liters per person per day, 100 liters per cattle per day, and 15 liters per goat per day, the total amount of water needed for domestic use is about 2 billion cubic meters per annum.

Snow-fed rivers have minimum flows in February, while non-snow-fed rivers have minimum flows in April. The total volume in February is 3 billion cubic meters (BCM), and

in April, it is 4 BCM (Table 1). Groundwater resources are used for drinking water supply in the valleys and plains, and the water supply in the Kathmandu Valley is also supplemented by groundwater. Due to over-extraction, groundwater resources are decreasing rapidly (DHM, 1997).

By 2019, only 51.69% of the population had piped water coverage in Nepal, with the remaining 48.31% relying on unpiped, locally and privately managed systems like private tube wells (DWSSM, 2019). By 2022, the proportion of the population using improved water supplies had reached 91%, whereas the proportion using improved sanitation facilities (excluding shared) was only 51% (JMP, 2023). Though the availability of water is sufficient, the majority of people live with minimal safe drinking water due to current scattered housing patterns and settlements, especially in hills and mountains, insufficient water infrastructure, and the drying up of spring sources due to climate change.

### *Irrigation uses*

Approximately 21% and 7% of Nepal's total area is cultivated agricultural land and uncultivated agricultural land, respectively (MoALD, 2021/22). The current agricultural land is not



adequately irrigated. More water is typically needed in sloping terrain than in plains (Shrestha, 1995). According to the statistical information on Nepalese agriculture (2076/77), the cultivated agricultural land is 30,910 square kilometers (21.0%), the uncultivated agricultural land is 10,300 square kilometers (7.0%), the forest land is 42,680 square kilometers (29.0%), the shrub land is 15,600 square kilometers (10.6%), the grassland and pasture is 17,660 square kilometers (12.0%), water bodies cover 3,830 square kilometers (2.6%), and other miscellaneous land is 26,200 square kilometers (17.8%) (Department of Livestock Services, 2022).

The present water consumption rate is less than 8% of the country's water potential for irrigation (Poudel, 2019). The amount of water required annually for irrigation is estimated to make up roughly 60-70% of the total water during non-monsoon periods (Bhusal, 1999). However, Nepali farmers have been facing water deficits even though there is enough water to irrigate all agricultural land providing available water for irrigation in hilly terrain has become technically and economically challenging due to the drying of sources of hilly streams caused by climate change. It is important to utilize proper technology and infrastructure to supply water to meet the demand for irrigation, domestic, and other uses in the country.

### Hydroelectricity

Due to extreme topographical variation appropriate for hydropower development, Nepali rivers are excellent sources of hydroelectricity. Under natural conditions and adopted design practices during the 1960s, the hydroelectric potential was estimated to be 83 thousand MW (megawatts), out of which 43 thousand MW was found to be feasible (Shrestha, 1995). By 2009, licenses issued and applications received amounted to 62,300 MW, out of which 53,000 MW were from identified projects above 100 MW and 9,300 MW were from projects less than 100 MW (Bhusal, 2015). The largest capacity projects identified are the Karnali River at Chisapani (10,500 MW), Mahakali River at Pancheswor (6,000 MW), and Koshi River at Chatara (3,000 MW). Therefore, with technological advancement and changes in design flow concepts, hydroelectric potential exceeds 100,000 MW.

Hydroelectricity is also a saleable commodity that needs to be developed and utilized to increase industrial and agricultural production, and it can be exported. Though Nepal had a 500 KW Pharping hydropower project operated in 1911 AD, Nepal could not tap her huge hydroelectric potential for a long time. As of December 22, 2023 (Table 4) data, hydropower capacity in operation is 2,618 MW, capacity under construction is 8,776 MW, and capacity licensed for study is 8,924 MW. The total capacity to be in operation will be 20,318 MW soon.

**Table 4: Hydropower licenses till 22 December 2023 (DOED)**

Capacity	Under Operation	License Issued		Total MW
		Construction	Study	
Less than 1 MW	14.22	17.64	8.85	40.71
Greater than 1 MW	2603.46	8758.05	8915.38	20276.89
Total	2617.68	8775.69	8924.23	20317.6
Total				20317.6

Source: DoED, 2023

Furthermore, if high dam storage projects with downstream benefits sharing are implemented, particularly with India and Bangladesh,

hydropower production in Nepal would greatly benefit Nepal and the region as a whole. Though hydropower is a clean energy resource, its

development is slowed due to various reasons, including financial constraints, environmental adversities, and also India's self-centric perception of Himalayan waters.

### ***Navigation and other uses***

Though challenging, the three major rivers in the Tarai can be harnessed for limited navigation. In the future, Nepal could have navigation access to the Indian Ocean only if India cooperates with the inland waterway (National Waterways Authority of India, 2018). However, navigation is a difficult endeavor in mountainous regions due to high flow velocity, sediment content, and high seasonal variation in water volume. Nevertheless, there would have been the possibility to craft boats to transport goods from the hills to the plains, as Japan had taken advantage of water current sailing boats more than 10 thousand years ago (Alcoforado, 2022). Fisheries are found to be feasible and profitable. River rafting, lakeside resorts, and riverbank restaurants are attracting the attention of tourists. However, Nepal has not yet created a favorable environment to fully exploit the benefits of its blue waters.

### **History of water resources cooperation with India: Policy and challenge**

India's National Water Policy 2012 considers water as a state subject (National Water Policy-2012). The policy admits that India will become 'water-stressed' by 2025 and 'water-scarce' by 2050. In addition to water recycling policies, India has launched the campaign "Catch the Rain" (Ministry of Jal Shakti, 2021). The policy is aware that friction in bilateral relations will increase if a mutually acceptable bilateral or multilateral framework for cooperation to deal with the integrated development of water resources is not effectively reworked (IDSA, September 2010). Neighbors in India have continuously raised concerns over regulating and sharing river waters. India's riparian relation/upstream-

downstream relation with its neighbors is progressively becoming bitterer to date.

Water resource development efforts with India have been initiated long ago and have resulted in several treaties. India primarily concentrates on irrigation and flood control benefits (National Water Policy-2012), while equitable benefit-sharing with Nepal is predominantly ignored (IDSA, September 2010). India's perception of Himalayan rivers is seriously hindering any third country's involvement in water resources development in Nepal. Unlike the policy of British rule in India, independent India is biased toward the water resources development of Nepal. A systematic review of the history of water resource development in India since British rule in present-day India is presented below. Accordingly, India has been enforcing water resources agreements with Nepal, primarily for their national interest.

### ***Policies before 1947 (Period of British Rule)***

The British colonial regime in India was dedicated to producing poppy and opium for exports to China, so irrigation was focused on those areas (Sarkar, 1983). Likely, the first initiation of cooperation in water resources at an official level was the letter by British India written to Nepal in 1874. It was about the four ponds (Sagars) - Marthi, Siswa, Bajah/Jamuwar, and Mahali (from east to west in order) straddling the Nepal-India border in Kapilvastu district. The issue was related to the inundation at the international border. It is said that the British had developed structures without inundating Nepalese territory. However, while independent India had renovated the Mahalisagar poundage, local people had noticed that its level was raised, which endangered huge swaths of land submersion within Nepal. In response to Nepal's concern, India had sceptically argued that the work was only the renovation already constructed in 1901 in consultation with the Nepalese government (Bajracharya, 2018).

In the years 1865-66, there was a great drought in the Champaran and Tirhut regions of Bihar, India. Water from the mountain stream was used by Nepalese farmers in the upper part. Farmers in India had requested Nepalese farmers in the upper part to release some water to irrigate their land. However, their requests could not be fulfilled due to the higher demand for irrigation within Nepal. Even after deadly droughts, there was no story of the fight for water rights; instead, the Tribeni Canal was envisioned. It is not known whether Nepal was asked on taking water from the border river or not. It might be that the British regime did not feel necessary as the water was diverted without constructing any weir or dam-like obstruction in the river bed.

To address droughts like those of 1873-74 in the Tirhut region and to provide irrigation in the region, British India proposed a barrage on the Kamala River. Lieutenant Colonel J. Manners Smith, the resident representative of Britain, had sent a letter to the Nepal Darbar in 1913. The proposed project intake was within Nepali territory. The project would irrigate 24,300 hectares of land in Nepal and 16,200 hectares of land in India (Singh, 2003). The British-India proposal seemed unbiased and practical, looking at who would irrigate more or less. However, the Kamala canal could not be materialized because the Nepal Government did not give permission. The writer did not find any records of conflicts in water sharing between British India and Nepal.

In 1920, when the Sarada Barrage Treaty was signed for harnessing the waters of the Mahakali River, the Sharada-Banwasa barrage (1928) was consensually surveyed since 1910 (Dhungel, 2022). British Ambassador J. Manners Smith asked for permission on 3 May 1916, to build the barrage. On 3 August 1920, Shri Teen Chandra Shamsheer's government agreed with the condition that Nepal should get 4000 acres of land from India in exchange for Nepal's land to be used by the barrage, plus Nepal should get 150 cusecs of water in winter (November to April) and 1000 cusecs of water in the rainy season (June

to October). Nepal had received equal land that was used by the Sharada Barrage as well as water as per her demand. There was land swapping between Nepal and British India regarding the land used by the Sharada Barrage and its auxiliary structures (Dhungel, 2022).

### ***Policies after 1947 – Period of independent India***

India started constructing the Tanakpur barrage in Mahakali unilaterally without getting consent from Nepal during the Panchayat government. The Nepali Congress Party's government, led by GP Koirala on 21 October 1992, gave consent to India to use 2.9 hectares of Nepalese land at Jimuwa to build a 577-meter embankment on the left bank of the Mahakali River attached to the Tanakpur barrage. In return, the Nepali Congress-led Government was satisfied with 2 MW unit free energy and a four-wheel-drive facility road from Tanakpur Dam to Mahendra Highway located in Mahendranagar. Soon after, India worked overnight to connect the left embankment of the Tanakpur Dam to the upper part of Nepal (Dhungel, 2022). Nepal possesses sovereignty rights to half the water of the Mahakali River for irrigation and half of the hydroelectricity generated from the border river. However, it could not happen. India is still forcefully conflicted in the integrated Mahakali Treaty (1996), demanding the prior appropriation of water rights of lower Sarada irrigation (Dhungel, 2022).

There was no provision for providing water in the Koshi River agreement like the Sarada barrage construction. Provisions related to the sovereignty of Nepal's part of the project area, inter-basin diversion, freedom of upstream water use and power generation, navigation rights, limited fishing rights, etc., were addressed only in the revision of 19 December 1966 (MoEWRI, 1966).

The Gandak treaty was signed during the Nepali Congress party's BP Koirala-led government, and the treaty is silent on expiry time, giving the Nepalese land used by the project under Indian

sovereignty unless the treaty is modified. The treaty has a provision to limit Narayani River water rights during the dry season by stating that inter-basin diversion upstream to the Barrage has to be agreed by India. With such provisions, the Gandak treaty is one of the worst treaties for Nepal. In addition, the left bank strengthening by India during and after the Triveni canal headworks and Gandak barrage has escalated land erosion towards Nepal in the Bhaishalotan area, due to which the river today has completely entered into Nepal. It has escalated border disputes (Bhusal & Dhungel, 2022).

Since India's independence (1947), there have been hurdles to the economic benefit of Nepal through water resources development. The Indian Ambassador to Nepal, Sir Chandeshwar Prasad Narayan Singh (1949-52), to Mohan Shamsher, then Prime Minister of Nepal, confided that the Indian government was soon executing a large Koshi High Dam project at Barahchhetra (inside Nepal), which would avail electricity at 2 Paisa per unit for Nepal (100 paisa equals to One Rupee), north Bihar, and Bengal. Singh advised Mohan Shamsher to discard Nepal's planned 22 MW Kaligandaki hydro-cum-irrigation project at Gaidakot, which would generate electricity at 6 paisa per unit. Believing the Indian ambassador, Mohan Shamsher dropped the project in 1948/49. Instead of Barahchhetra, the Koshi barrage was constructed on the Indo-Nepal border, which is solely designed for flood control and irrigation benefit to India only (quoted in Pande, 1982).

In the Panchayat period (Adhikary, 1995), India objected to foreign investment in the Sikta Irrigation Project in West Rapti by writing a letter to the Asian Development Bank in 1979/80 (Sikta Irrigation Project, 2018). The Sikta irrigation diverts Rapti river water from about 50 km upstream of the Laxmanpur barrage, although the barrage is built on the territory of India. The Panchayat regime could not dare to

continue constructing Sikta irrigation with the internal budget. After many years gap, it is now constructed by a Nepal's own resource. This is also another event where India has barred Nepal's economic development.

On 21 October 2014, Nepal and India signed an Agreement on Electric Power Trade, Cross-border Transmission Interconnection and Grid Connectivity, and non-discriminatory access to cross-border interconnections (MoEWRI, 2014). The SAARC member states, on 27 November 2014, signed the SAARC Framework Agreement for Energy Cooperation (Electricity) (SAARC Agreement, 2014). The agenda of the SAARC grid connectivity proposed by Nepal at the SAARC summit in 2014 was initially disregarded by Pakistan. But when Nepal's PM Shusil Koirala convinced Pakistan PM, Nabab Sharif, the agenda was passed. However, India rebelliously added hurdles to the SAARC grid vision by changing her policy guidelines on Cross Border Trade of Electricity in 2016, 2018, and 2021 (Government of India, 2016, 2018, 2022). These guidelines are restrictive to non-discriminatory access. The guidelines allow the import of electricity from companies whose majority shareholders are Indian. They have been framed in such a way that no foreign investor other than Indian investors would feel attracted to invest in the hydropower sector in Nepal. The recently signed agreement on power trade between Nepal and India (Reuters, 2024) is also in line with the existing hurdling policy. India has not yet preferred to enter into regional sharing on multipurpose water resources project development. India still has a discriminatory attitude in water and energy policy with neighbors, including Nepal, and links causes with the rivalry with China and Pakistan.

### **Other water resource cooperations**

#### ***India–China***

Though there is a memorandum of understanding (MoU) to share hydrological

information on the Brahmaputra River (MoEA, GoI, 2013, DWR, GoI, 2008-18), India–China relations are overshadowed by border disputes and political rivalry (IDSA, 2010). India aims to create global awareness about the water resources in Tibet and build regional pressure to curb China's aggressive south-to-north water diversion projects on the rivers that originate from the Tibet region, particularly on the Yarlung-Tsangpo, as well as the overall hydrological dynamics in South Asia. India views that ‘Tibet's water is for humanity, not for China alone’ context. India wants Bangladesh to align with India in opposing the Chinese water diversion policy” (IDSA, 2010).

### ***India–Pakistan***

The Indus Water Treaty (IWT-1960) allows the Indus, Chenab, and Jhelum rivers to flow to Pakistan, while the Beas, Ravi, and Sutlej rivers flow to India. Since the ratification of the treaty in 1960, India and Pakistan have not engaged in any water wars, despite being involved in several military conflicts. However, India considers that the Indus Water Treaty (IWT-1960) is generous towards Pakistan and remains alert for a unilateral abrogation, which is permissible in international law if Pakistan persists in supporting terrorism. Furthermore, India considers its rights to harness hydropower potential on the western rivers within the bounds of the treaty (IDSA, 2010).

### ***India–Bangladesh***

The Farakka Barrage was erected by India in 1975 to divert water from the Ganges River system. Seemingly, India feels that the Ganges Treaty is generous towards Bangladesh (IDSA, 2010), whereas Bangladesh feels the reverse and continues to complain against the treaty and demand more water releases. With Bangladesh, India deals with water issues in the overall political and security context (National Water Policy- 2012).

### ***India–Bhutan***

India's cooperation with Bhutan on water issues has been proceeding satisfactorily. Bhutan's

security falls under the Indian security umbrella. Therefore, Bhutan's policy does not dare to openly question Indian policy. However, Bhutan wants a basin-oriented approach involving Nepal, Bhutan, Bangladesh, China, and India to manage water resources from a regional perspective (IDSA, 2010).

Like Nepal, Lesotho is a landlocked country surrounded by South Africa and intersected by a network of rivers and high-altitude mountain ranges. America and Canada share similar cultures, languages, and rivers.

### ***Lesotho and South Africa***

Lesotho manages transboundary water resources, safeguarding her interests in a way that ensures maximum benefits while acknowledging her obligations to downstream users under international law. Lesotho has devised a strategy to cooperate with other riparian countries in the development, optimal utilization, and protection of transboundary waters without compromising the country's sovereignty. The Lesotho Water and Sanitation Policy (LWSP) aligns with the global and regional consensus embodied in Agenda 21, the Dublin Principles, the Helsinki Rules, the Johannesburg Plan of Implementation, the Global Water Partnership, SADC (Southern African Development Community) Declaration, Southern African Vision for Water and Environment, SADC Regional Water Policy, and SADC Protocol on Shared Watercourses. It also aims to achieve this objective equitably without compromising the sustainability of vital environmental systems. It acknowledges that proper planning, conservation, development, and management of water resources require a shared vision and ownership (Minister of Natural Resources, 2007).

South Africa and Lesotho agreed on the Lesotho Highlands Water Project. South Africa receives the needed water, whereas Lesotho earns income from the sale of the water and electricity. The project also provides employment for many people. South Africa undertakes to share with Lesotho, by way of royalty payments, based

on fifty-six percent for Lesotho and forty-four percent for South Africa (The Food and Agriculture Organization (FAO, 1986).

South Africa's water policy underwent rapid changes with the new National Water Law of 1998 after the country's radical political changes in the early 1990s (Karodia & Weston, 2001). Policy on international water resources, specifically shared river systems, directs management in a manner that optimizes the benefits for all parties in a spirit of mutual cooperation, and respects allocations agreed upon for downstream countries (Asmal, 1997). South Africa ensures accommodating water demands through cooperation, not conflict, in harmony with the needs of common goals and the protection of the environment. South Africa considers international customs and practices such as the Helsinki Rules and also assists in developing regional cooperation through various Southern African Development Community (SADC) initiatives, including the SADC Protocol. The protocol has, to date, only been ratified by South Africa, Lesotho, Botswana, and Mauritius, on Shared Water Course Systems. A Technical Committee, involving all four basin states (South Africa, Botswana, Zimbabwe, and Mozambique), has been established to provide for general planning and liaison in common basins. The Lesotho Highlands Development and the Komati Basin Development are two important examples of institutional arrangements specially created to promote specific development projects (Asmal, 1997).

### ***USA and Canada in Columbia River Treaty***

The treaty between Canada and the United States of America relating to the cooperative development of the water resources of the Columbia River Basin was signed on January 17, 1961 (Columbia-River-Treaty-Protocol-and-Documents.pdf, 2012). This is a good example of downstream power benefits sharing. The United States provides the Canadian Entitlement to British Columbia as energy

and capacity, not money. The U.S. delivers to Canada half of the estimated increase in U.S. downstream power benefits, on an ongoing basis (the Canadian Entitlement), and makes a one-time monetary payment as each of the dams is completed for half of the value of the estimated future flood damages prevented in the U.S (Hossen et al., 2023).

### **Issues and challenges on water resources development**

The preceding discourse unveils the obstacles encountered in the development of water resources. A few other significant problems are:

- The Himalayan glaciers are melting more quickly due to climate change, which may result in short-term improvements in water flow but long-term reductions in water supply.
- The region has fragile geology and diverse geography, making development and maintenance difficult.
- The increasing frequency of extreme weather events, such as droughts and floods, affects agricultural productivity and the management of water resources.
- The absence of a comprehensive and coordinated policy about water resources results in fragmented activities and inefficient utilization of resources.
- Environmental issues include the potential for ecological damage, biodiversity loss, and community displacement of local communities in cases of storage schemes.
- Political instability hinders foreign investments.
- Lack of effective regional policies to tackle transboundary water issues like equitable sharing of resources and benefits.

- Despite hydroelectricity being a clean and renewable energy resource, the development of hydropower is being hindered by various factors like financial constraints, environmental challenges, and India's self-centric perception regarding the utilization of Himalayan waters.
- Above all, robust cooperation among countries of the Indian subcontinent is politically and diplomatically challenging.

India is concerned about several issues, including dwindling water supplies, rising population, fast urbanization, declining groundwater tables from overexploitation, and decreased dry season flows brought on by climate change. The trend of urbanization and the expansion of cities in India have severely stressed groundwater resources (Narain & Roth, 2016). India's policies consider the Himalayan river waters as strategic resources. The increasing water and energy demand have made India more conservative in regional and bilateral cooperation and have been influenced by power dynamics.

Effective cooperation on water resources between Nepal and India requires addressing historical grievances, ensuring equitable benefits, enhancing transparency, and strengthening institutional frameworks. In the context of upstream-downstream dynamics, Nepal has leverage over the flow of rivers into India, and India and Bangladesh. Regional cooperation on water resources is crucial to address the challenges posed by climate change. However, water resources are considered a politically sensitive issue by India, which has been vying for regional advantages from Nepal's enormous hydroelectric potential.

### **Reflection and the way forward**

PMPD asserts that access to and control over natural resources fundamentally depend

on political decisions and power relations. Colonialism, globalization, and especially neoliberalism have massively destroyed diversity and differences, distancing people from their access to natural resources and further commodifying nature (Chapagain, 2023). Nepal was never colonized, and its people were honest and generous. During the Rana's autocratic rule of 104 years and the king's absolute rule for a 30-year party-less system, the livelihoods of the Nepalese people did not improve. Water resources are valuable resources naturally shared, bounded by watershed divides, not by political boundaries. PMPD believes in cooperation based on equality and mutual benefit from shared resources. PMPD envisions that the state regime creates a favorable environment for attracting foreign investment and co-investment for the progress and prosperity of the people. The state bears responsibility for providing electricity and drinking water needed for sustaining livelihoods (Bhandari, 1993). Access to water is a human right. PMPD firmly argues that all people possess rights to land, water, air, and light. These values, along with the right to a clean environment, are included as fundamental rights in the constitution of Nepal. Clause 51 (g) describes the state's policies relating to the protection, promotion, and use of natural resources, the multi-purpose development of water resources, reliable supply of energy affordably and easily, and sustainable and reliable irrigation (The Constitution of Nepal, 2015).

Integrated water resources management (IWRM) promotes the coordinated development and management of water, land, and related resources to maximize economic and social welfare equitably without compromising the sustainability of vital ecosystems (Global Water Partnerships, 1996). Similarly, the UN Conference on the Human Environment (Stockholm Conference, 1972), and the International Drinking Water Supply and Sanitation Decade launch (United Nations Water Conference, 1977, UN General Assembly, 1997), are some other international initiatives related to water resources. PMPD conceptualizes integrated water resources management (IWRM)

as a coordinated development and management of water, land, and related resources, aiming to optimize economic and social welfare equitably while maintaining the sustainability of essential ecosystems. It advocates for the sustainable development of water resources (Bhandari, 1993). Even though the development of hydroelectricity by private parties has been accelerating in the last decades, Nepal could not effectively implement the Water Resources Strategy-Nepal (2002) and National Water Plan-Nepal(2005), which were formulated for the sustainable and holistic management of water resources. In 2020, a new National Water Resources Policy is in place, aiming to contribute to economic prosperity and social transformation through multi-faceted, equitable, and sustainable development and multi-use of water resources, and ensuring sustainable and reliable energy supply by developing renewable energy and irrigation by controlling and managing rivers (MoEWRI, GoN, 2020).

The rivers of Nepal possess enormous potential for hydroelectricity. PMPD emphasizes that energy policy be integrated with agricultural development and industrialization. It acknowledges the inter-basin and trans-basin water transfer. PMPD envisages the public-private partnership (PPP model) with people's participation in the development of water resources. Nepal has recognized the Public-Private Partnership (PPP) model as a crucial strategy to address the country's infrastructure deficits and service delivery challenges and also a mechanism for sharing the benefit of natural resources. The Hydropower Policy & Electricity Act 1992, and the Foreign Investment & Technology Transfer Act -1999 legalized the PPP model. The energy policy includes making electricity available at a reasonable price in the country. PMPD recognizes the regional connectivity of electricity transmission lines among SAARC countries and exports of electricity (Bhandari, 1993).

In line with his PMPD philosophy, Madan Bhandari stood extremely against the Tanakpur Agreement of 21 October 1992 between India and Nepal, sowing nationwide awareness that the Agreement suppressed Nepal's water rights and sovereignty. As a member of parliament, Bhandari firmly asserted his party's position on the infamous Tanakpur Treaty, citing Article 126 sub-clause 2 of the constitution. Regrettably, his vision of rectifying discriminatory treaties, dispelling dangerous clouds over Nepal's sovereignty, bringing prosperity to both Nepal and the Nepalese people, and bolstering People's Multiparty Democracy remained unfulfilled as a result of his tragic death in a conspiratorial car accident on May 16, 1993. This occurred mysteriously just six months after the Tanakpur agreement, less than two years after he gave an interview for Newsweek (Litvin, 1991), and just two years after he gave a well-respected speech in Chabahil, Kathmandu (<https://youtu.be/1Ik97LImB0c>, 19 March 1991). The upper riparian rights are paramount by nature and by internationally recognized conventions, even though a river, from source to mouth, is like a mother to all life within its watershed. The possibility of working with India following PMPD is consistent with both established international rules and natural rights. Human rights include water rights, and the People's Multiparty Democracy (PMPD) is adamant that everyone has the right to air, light, land, and water. PMPD is a proponent of equality and reciprocal gain from common resources as the foundation for cooperation.

## **Conclusion**

Water resources development in Nepal faces challenges due to fragile geology, climate change, extreme weather events, environmental concerns, political instability, and a lack of effective transboundary water management policies. Since independence, India has strategically hindered major water resources projects focused on Nepal's benefit,



instead promoting projects designed for its own advantage. Nepal-India water treaties were negotiated during political transition periods in Nepal such as the Koshi after 2007/08, Gandak after 2015/17, and Tanakpur after 2046/47 BS, mainly guided by India. India seeks regional advantages from Nepal's major rivers and overall hydroelectric potential. Addressing historical grievances, enhancing transparency, and strengthening institutional frameworks are essential for successful cooperation with India. Effective cooperation on water resource development between Nepal and India is crucial to ensure equitable benefits.

In PMPD, Bhandari considered the need for bilateral and regional cooperation on water resources development to uplift Nepal's economy. The water resources of Nepal, if optimally harnessed especially through hydropower and flood water storage, could make substantial contributions not only to Nepal's economic uplift but also to the socio-economic development of India and South Asia. Benefits from hydropower development could be received directly through commodity sales and exports, and indirectly through maximized domestic uses across multiple sectors like industry and transportation. Integrating agricultural and industrial development with sustainable support from hydropower benefits from Nepalese rivers could form the backbone of the national economy. However, water resources have become an overly sensitive subject in Nepal-India relations. India has indirectly imposed an autocratic policy on rivers from Nepal. In PMPD, Bhandari conceptualizes sustainable water resources development, advocates integrated water resources management, and firmly argues that all people possess rights to water. It also aims to promote regional connectivity enabling shared hydropower benefits. Water resource development should consider environmental protection and ecosystem stability. There are some international initiatives and forums with focused themes related to water.

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