Water Policy 19 (2017) 791–819

Hydropolitics and hydropolitical dynamics between India and Nepal: an event-based study

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Abstract

India and Nepal not only share common borders and cultures, but also share precious freshwater sources, i.e., rivers. Rivers have been discussed often in the political corridors because they cross international borders, which transform water reserves into a competitive resource and lead to hydropolitical dynamics between riparian countries. Nepal and India are two of the major riparian nations that share the mighty and complex Ganges Basin. The objective here was to study the more-than-a-century-old hydro-diplomacy between India and Nepal, passing through tumultuous political scenarios to understand how water relations have been shaped and reshaped with time. For this, a database of historical individual events/actions of water cooperation and conflict from 1874 to 2014 was compiled. These events/actions were ranked by intensity, using precise definitions of conflict and cooperation as suggested by the Transboundary Freshwater Dispute Database under the Basins at Risk project formulated at Oregon State University. Statistical analyses indicated cooperative events greatly outnumbered conflictive events. Out of 351 events, only 4% were conflictive, 92% were cooperative, and the remaining 4% were neutral. The study revealed an abundance of cooperative events; however, when seen through the lens of conflict-cooperation levels, the findings indicated a moderately positive cooperation, without much concrete action.

Keywords: Basins at Risk scale; Conflict-cooperation levels; Ganges Basin; Hydro-diplomacy; India-Nepal; Statistical analyses

1. Introduction

A country's well-being and economic success are intricately linked to its natural resources, especially rivers, which are rich sources of freshwater. But when rivers flow across political borders (transboundary rivers), these water reserves are transformed into a competitive resource, leading to political tension

doi: 10.2166/wp.2017.063

between countries (Stahl, 2005). The politics of fresh water in international contexts is becoming increasingly contentious. The issues of cross-border water sharing, use, and management need greater attention, as giant hydropower and irrigation projects are gradually performing key roles in defining international relations. Socioeconomic development has resulted in the rapid drawdown of freshwater reserves all over the world, making it a scarce resource. Increasing modern agriculture and irrigation systems can lead to more hydropolitical dynamics (Valipour, 2015; Yannopoulos *et al.*, 2015; Valipour & Singh, 2016). With the pressure building on freshwater resources, transboundary water management is going to play an increasingly important role, both at the regional and international level (Nicol *et al.*, 2001; Jägerskog *et al.*, 2007).

According to the Transboundary Freshwater Dispute Database (TFDD), there are 276 international transboundary river basins (TFDD, 2012), which cover more than 45% of the land surface on the Earth (Loucks & van Beek, 2005). A total of 145 countries, which constitute over 75% of all countries, have shared river basins within their boundaries, while 33 countries have more than 95% of their territorial dominion within international river basins. Internationally shared river basins are home to over 40% of the world's population and contribute to approximately 60% of global river flows (Wolf *et al.*, 1999; Draper, 2002; Giordano & Wolf, 2003; Sadoff & Grey, 2005).

Convergence on cooperation by riparian states can encourage, cement, and reinforce power imbalances and injustice. This may lead less hegemonic riparian states to a dilemma between an imbalanced cooperative agreement with some accompanying benefits and no agreement and no accompanying benefits, but the flexibility to pursue more just power dynamics (Zeitoun & Mirumachi, 2008). Zeitoun & Mirumachi (2008) stated that cross-border (transboundary) cooperation overlooks the needs and values of various groups and stakeholders (e.g., states, ethnic minorities, etc.) that are not represented in decision-making. In India, water is primarily a state subject. Hence, it is very important for the central government to consider the views of the states as without their support any international water agreement would be practically impossible.

An important aspect in transboundary water resources management and hydropolitics is the integration of cooperation and conflict resolution with the management of transboundary rivers. This requires a good understanding of the history and patterns of conflict and cooperation among riparian countries sharing transboundary basins. In addition to the above, the different factors that influence hydropolitical relations also need to be understood (Stahl, 2005). Only in the last decade have researchers begun to collect data in order to analyse these issues on regional and global scales (Wolf *et al.*, 2003; Saleth & Dinar, 2004; Stahl, 2005).

International relations scholarship is often categorized by its analytic purpose, as relating to metaphor, history, theory, engineering, and pattern recognition (Chan, 2002). Edward Azar's Conflict and Peace Databank (COPDAB) International Cooperation and Conflict scale categorized events in terms of the nature and intensity of conflict or cooperation. The COPDAB scale provides a measure of the international conflict/cooperation intensity for individual nations and between pairs of nations over time periods ranging from single days to multiple years (Azar, 1980). The COPDAB scale was adapted for water events at Oregon State University to formulate the Basins at Risk (BAR) scale (Yoffe & Giordano, 2001).

The TFDD, also developed at Oregon State University, uses the BAR scale to evaluate interactions over shared water resources. The database provides a framework for quantitative, global-scale explorations of the relationship between freshwater resources and international cooperation and conflict. Event data serve as a bridge from traditional diplomatic history to quantitative analyses of international politics

(McClelland, 1960). The TFDD was the first attempt to code event data sets specifically related to water resource issues (Yoffe *et al.*, 2004). Events are defined as

> '*instances of conflict or cooperation that occurred within an international river basin, that involve the nations riparian to the river, and that concern freshwater as a scarce or consumable resource (e.g., water quality, water quantity) or as a quantity to be managed (e.g., flooding or flood control, managing water levels for navigational purposes)*' (Yoffe *et al.*, 2004).

The water event database is a unique resource that allows the evaluation of historical events of water conflict and cooperation and the exploration of relationships between events. The event data set provides a variety of opportunities to analyse water-related conflict-cooperation behaviour globally (Stahl, 2005). For example, it is not only possible to extract and analyse events with particular intensities, such as the extremes. But, after choosing a transformation, aggregated measures of conflict/cooperation for a range of spatial and temporal scales (e.g., basin, region, country, year, etc.) can be calculated (Yoffe *et al.*, 2004). It can be used to assess the risk for conflict or potential for cooperation, as employed by Wolf *et al.* (2003), and has the potential to guide international policy with informed decisions.

The water-event database methodology has the potential to provide a detailed picture of patterns of historical conflict and cooperation between India and Nepal. This can open up new avenues of understanding about their hydropolitical relationship concerning the transboundary Ganges River of South Asia. The Ganges flows through four countries: China, Nepal, India, and Bangladesh. This study focuses on the region shared between India and Nepal, where Nepal is the upper riparian, while India is the lower riparian. The geography of Nepal and India pushes both countries to engage in many spheres, including cultural, social, economic, and political. Given that all rivers in Nepal drain into India, water resources is an important issue, as well as a very sensitive one (Dhungel & Pun, 2009). Water is a scarce resource across many regions in the world including South Asia, which houses a large share of the world's population.

Nepal, however, is gifted with abundant freshwater reserves, which form a strategically important natural resource. Though the bulk of this resource has not yet been exploited, it has the potential to transform the status of Nepal. All of Nepal's rivers contribute to the flow of the Ganges downstream in India. Nepal must cooperate with India and Bangladesh, to obtain optimum benefit from her more than 6,000 rivers with a combined run-off of about 200×10^9 m^3 (billion cubic metres) (Sharma, 1997; Bhusal, 1999). Similarly, her neighbours would immensely benefit if this resource were harnessed in such a way that each of the cooperating countries could be in a win-win situation. Thus, these rivers, if properly harnessed, have the potential to substantially contribute to the socioeconomic development of not only the people of Nepal, but also millions of people living in the Gangetic belts of South Asia (Dhungel & Pun, 2009). Gaining meaningful insights into Indo-Nepal hydro-diplomacy is highly important for overcoming barriers to agreement on numerous water resources projects.

The objective here was to study the more-than-a-century-old hydro-diplomacy between India and Nepal, passing through tumultuous political scenarios, and also to understand how the water relations have been shaped and reshaped with time. The history of the water resources relationship between these two nations, based on available records, is more than 140 years old. Even during British India, both countries were engaged in cooperation in water resources at an official level. The two countries have been engaged in numerous agreements, starting with the Sarada Barrage agreement in 1920. There is hardly a river left over which Nepal and India have not reached an understanding. However,

the relationship between the two countries has yet to satisfy the people of either country (Dhungel & Pun, 2009). Although hydropolitical relations between Nepal and India have been largely considered to be normal, and there have been developments, the progress of events has been far from satisfactory. This study has been undertaken to examine the events and developments more closely and explore the hydropolitics involving Nepal and India in order to create an in-depth understanding of the different facets of their hydropolitical relationship.

2. Study area

The study area consists of a portion of the Ganges River system, a major Himalayan river system of South Asia. The scale of the Ganges River Basin is staggering: it is one of the largest basins in the world, encompassing an area of almost 1.2 million km^2 (World Bank, 2014). The basin spans four different countries (Figure 1 and Table 1), making it an international transboundary river, and it represents the majority of the region's water resources. However, despite the fact that Nepal and

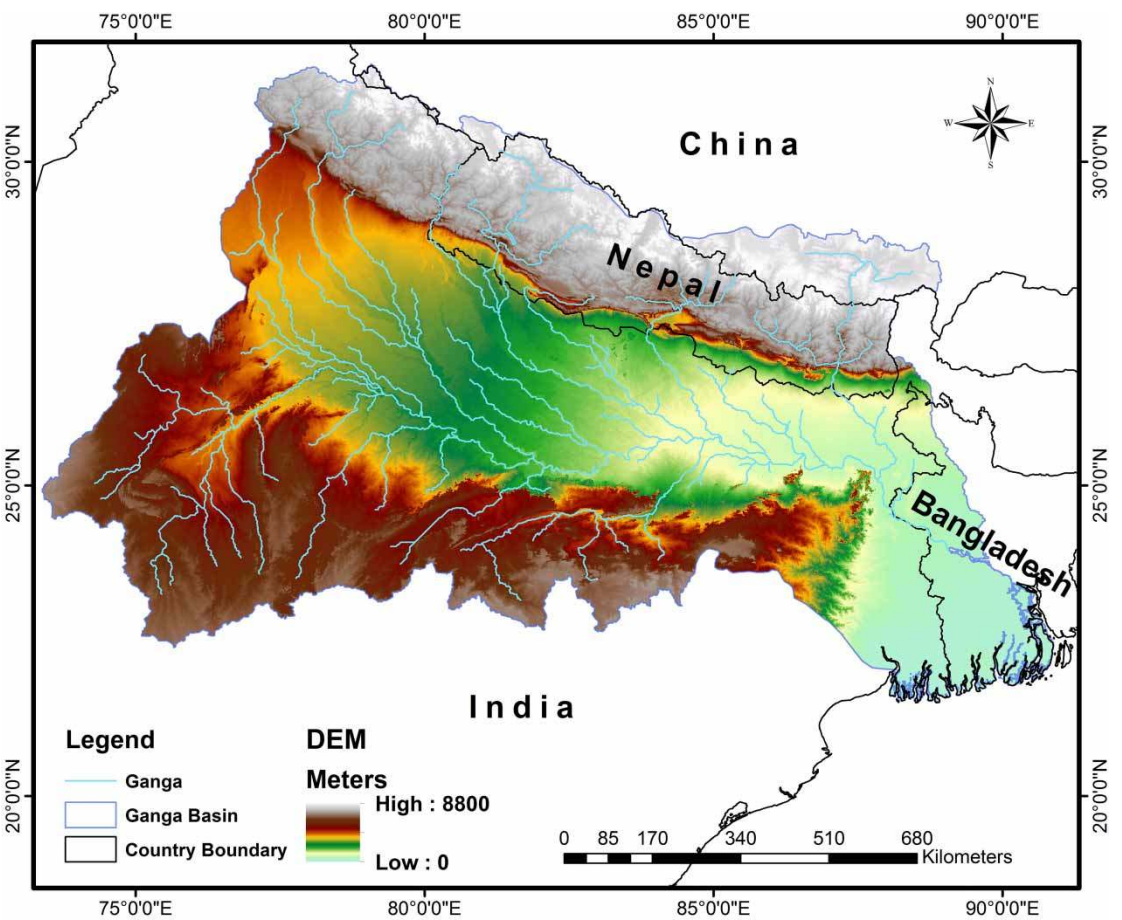

Fig. 1. Ganges Basin map (World Bank, 2014).

Table 1. Distribution of Ganges Basin across riparian countries (Frenken, 2013).

Basin	Area (km^2)	Country	Area (km^2)	% of total basin area	% of total country area
Ganges	1,087,300	India	860,000	79	26
		China	33,500	3	0.3
		Nepal	147,500	14	100
		Bangladesh	46,300	4	32

Bangladesh represent relatively small fractions of the basin in land area, all of Nepal and over one quarter of Bangladesh lie within the basin; thus, the Ganges remains a hugely important river system to these countries (World Bank, 2014).

The Ganges has a complex hydrology, with pronounced seasonal and climate variability. The three-month monsoon, from June to September, delivers about 80% of the annual rainfall. There is a huge asymmetry in the contribution of flow by the riparian nations as well. Nepal occupies only 14% of the Ganges Basin but contributes around 70% of the lean season (October to May) flow and around 40% of the average annual flow.

Home to over 655 million people, the Ganges is the world's most populous river basin, with an average population density of 551 people per km^2. Poverty is widespread; the average gross domestic product per capita is under US$2 per day and the poverty rate is around 30% (World Bank, 2014). The large population, coupled with rapid economic growth, has driven ever-increasing demands for water and energy, putting these demands at the very heart of the region's development.

3. Methodological approach: data compilation and integration

The goal was to collect and compile historical records of water-related events involving both conflict and cooperation. The resulting database could then be analysed in order to contribute to an in-depth understanding of the hydropolitics between India and Nepal. The authors began by creating a database of water-related events that have impacted the decision making of water resources professionals in both nations. A preliminary investigation was conducted that involved an intensive search of treaties, agreements, policy documents, government documents, joint communiqués, joint press statements, joint working group meeting agendas, letters of communication, reports, books, research and review papers, manuscripts, print and electronic newspaper articles, and maps in order to create the database of events. Some of the events that involved both India and Nepal were directly incorporated from the TFDD. Multiple searches were carried out to prevent missing events. In addition, the authors incorporated information from historical analyses and independent case studies.

3.1. Database components

Historical individual events/actions of water cooperation/conflict from 1874 to 2014 were compiled into the database. The basin or the sub-basin involved in the event was noted, along with the issues dealt with in the event. Then, the events/actions were ranked by intensity, using precise definitions of conflict and cooperation as suggested by the TFDD under the BAR project. Each incident in the database included the following information:

- DATE – the date of the incident (or closest approximation thereof). The dates are in day/month/year format. The last date of the event was used for events covering a period of days. If only the year was available, the date convention of 01/01/year was used; if only month and year were available, the 1st of the month was used.
- BCODE – the basin in which the incident or event occurred, indicated by a four-letter code (see Table 2). The Kosi, Mahakali, Karnali, Gandak and Mahananda are the sub-basins of the Ganges flowing from Nepal to India. When the event included both the nations as a whole then it was considered to fall in the Ganges Basin.
- EVENT_SUMMARY – a summary describing the incident or event.
- ISSUE_TYPE 1, 2, or 3 – Issue_Type1 is for the main issue area of an incident; Issue_Type2 and Issue_Type3 are for additional issue areas. See Table 3 for a list and description of issue areas.
- BAR_SCALE – the intensity (or category) of the incident, based on the BAR scale of cooperation and conflict (Table 4). A numerical score ranging from −7 to +7 was used, with −7 denoting the most negative events, 0 denoting neutral events, and +7 denoting the most positive events.

Table 2. Basin coding and description.

Basin code	Basin name
Gngs	Ganges
Kosi	Kosi
Kali	Mahakali
Krnl	Karnali
Gndk	Gandak
Maha	Mahananda

Table 3. Issue area with description.

Issue area	Description of issue areas	
1	Water quality	Events relating to water quality or water-related environmental concerns
2	Water quantity	Events relating to water quantity
3	Hydropower	Events relating to hydroelectricity or hydropower facilities
4	Navigation	Events relating to navigation, shipping, ports
5	Fishing	Events relating to fishing
6	Flood control/relief	Events relating to flooding, flood control, flood damage, flood relief
7	Economic development	General economic/regional development
8	Joint management	Events involving joint management of basin or water resources, especially where the management concerns cover a range of issue areas
9	Irrigation	Events relating to irrigation of agricultural areas
10	Infrastructure/ development	Events relating to the infrastructure or development projects, including dams, barrages, draining of swamps for development purposes, canals
11	Technical cooperation/ assistance	Events relating to technical or economic cooperation or assistance, including project evaluations or river surveys and funds for ranges of improvements to water-related technology/infrastructure
12	Border issues	Events relating to rivers as shared borders/boundaries
13	Territorial issues	Events relating to territorial claims, where the territory is associated with a water body, e.g., a river island

Table 4. Water event intensity scale with CCLs adapted from Stahl (2005).

BAR scale	Event description	CCLs
−7	Formal declaration of war	Most conflictive
−6	Extensive war acts causing deaths, dislocation or high strategic cost	
−5	Small scale military acts	
−4	Political-military hostile actions	Conflictive
−3	Diplomatic-economic hostile actions. Unilateral construction of water projects against another country's protests; reducing flow of water to another country; abrogation of a water agreement	
−2	Strong verbal expressions displaying hostility in interaction. Official interactions only	
−1	Mild verbal expressions displaying discord in interaction. Both unofficial and official, including diplomatic notes of protest	Neutral
0	Neutral or non-significant acts for the inter-nation situation	
1	Minor official exchanges, talks or policy expressions–mild verbal support	
2	Official verbal support of goals, values, or regime	Cooperative
3	Cultural or scientific agreement or support (nonstrategic). Agreements to set up cooperative working groups	
4	Non-military economic, technological or industrial agreement. Legal, cooperative actions between nations that are not treaties; cooperative projects for watershed management, irrigation, poverty-alleviation	
5	Military economic or strategic support	Most cooperative
6	Major strategic alliance (regional or international). International Freshwater Treaty	
7	Voluntary unification into one nation	

- MACRO_EVENT – coder defined designations used to track the progression of ongoing interactions through time. Individual events that pertained to the same event were given the same macro-event designation.

After the database was created, the data could then be sorted and grouped, for example, by events, basin, macro-event, and/or intensity of events based on the BAR scale and even on temporal scales. The BAR scale categories and event descriptions are shown in Table 4. The conflict-cooperation levels (CCLs) were incorporated from the work of Stahl (2005). The 15 BAR-scale categories were aggregated to five CCLs ranging from 'most conflictive' to 'most cooperative' events (Table 4). The aggregated classes of each of the three grouped BAR scales denote violent conflict, political conflict, neutral verbal interactions, moderate cooperation, and active cooperation or treaty signature. This was included in the study to counter the anomalies of the average of all historic events on the conflict-cooperation scale, which could conceal a possible relation to events of specific intensity; whereas analysing only specific events, such as the extremes, ignores moderating information from the entire history. A sample of the structure of the event database is shown in Table 5.

4. Results and discussion

Indo-Nepal hydro-diplomacy has evolved in stages. During the period under consideration (1874–2014), there were many significant ups and downs, a number of agreements and treaties signed, and even some 'rough patches' of economic blockades. Over this 140-year period, however, the events

Table 5. Illustration of the structure of the event database.

S. No.	DATE	BCODE	EVENT_SUMMARY	ISSUE_TYPE1	ISSUE_TYPE2	ISSUE_TYPE3	BAR_SCALE	MACRO_EVENT
1	1/1/1874	Kali	Agree to maintain water levels of three reservoirs located on the international border	12	0	0	1	
2	2/12/1897	Kosi	Kosi Barrage at Chatra approved by Nepal's PM	10	0	0	2	
3	6/1/1897	Kali	Maintain the existing levels in the three reservoirs to be those of 1874	12	0	0	1	
4	5/14/1898	Kali	Letter discussing the issue of three reservoirs more interestingly as a boundary dispute and maintenance of water levels in the reservoirs	12	0	0	1	
5	01-01-1901	Kali	Seek permission for the survey of Mahakali (Sarada) River for Sarada – Ganges – Jamuna Feeder project (Banbasa Barrage)	11	0	0	1	Sarada Agreement
6	01-01-1910	Kali	Survey of Sarada (Mahakali) approved	11	0	0	2	Sarada Agreement
7	03-05-1916	Kali	Request for Nepalese territory to tie up the left or eastern flank of the Sarada River to higher ground in Nepal	10	0	0	2	Sarada Agreement
8	23-08-1920	Kali	Request approved on Sarada Barrage, in exchange of 4,093.88 acre land	10	0	0	4	Sarada Agreement
9	01-01-1922	Kosi	Construction of Chandra Canal in Nepal on Trijuga Khola River under the supervision of British engineer	11	0	0	4	
10	01-01-1928	Kali	Banbasa Barrage completed and inaugurated on the Sarada River	10	0	0	2	Sarada Agreement

of cooperation heavily outnumbered events of conflict. To explore this evolution further, the results were examined for overall patterns, as well as temporally (both by the 140-year timeline and by three time phases) and spatially. The timeline for study was divided into three phases: (1) 01/01/1874–14/08/1947, during the era of British India; (2) 15/08/1947–31/03/1990, from Indian Independence until the imposition of the economic blockade on Nepal by India; and (3) 01/04/1990–31/12/2014, from the end of the economic blockade until the present era. The analysis was also split into various dimensions, such as the sub-basin level, issue type, and event type, in order to gain additional insights beyond the nationalistic viewpoints of India and Nepal.

4.1. Overall patterns

Figure 2 displays the total number of events by event type, which corresponds to the BAR scale. In the pie chart, both the number of events in each BAR scale and the percentage contribution out of the total number of events have been highlighted. From a total of 351 events, 13 were conflictive (4%), 325 were cooperative (92%), and the remaining 13 were neutral (4%). The major share (81%) was contributed by events categorized as BAR scale 1 (23%), 2 (29%), and 3 (29%), which correspond to mild verbal support, official verbal support and cultural, scientific agreement/support, respectively. Figure 3 highlights the count of events as per the CCLs defined by Stahl (2005). Cooperative and neutral events comprised 69% and 29% of the events, respectively, which indicates moderately positive cooperation, yet without much concrete action.

As shown in Figure 4, categorizing the events according to issue areas indicated the dominance of joint management (29%) and infrastructure (27%), followed by technical cooperation (16%),

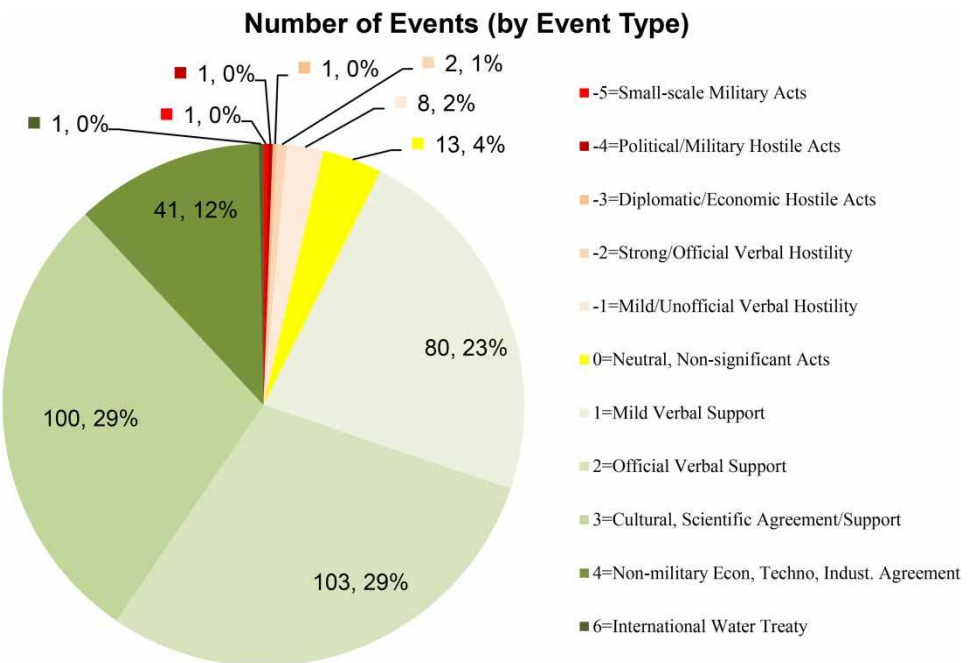

Fig. 2. Total number of events by BAR intensity scale.

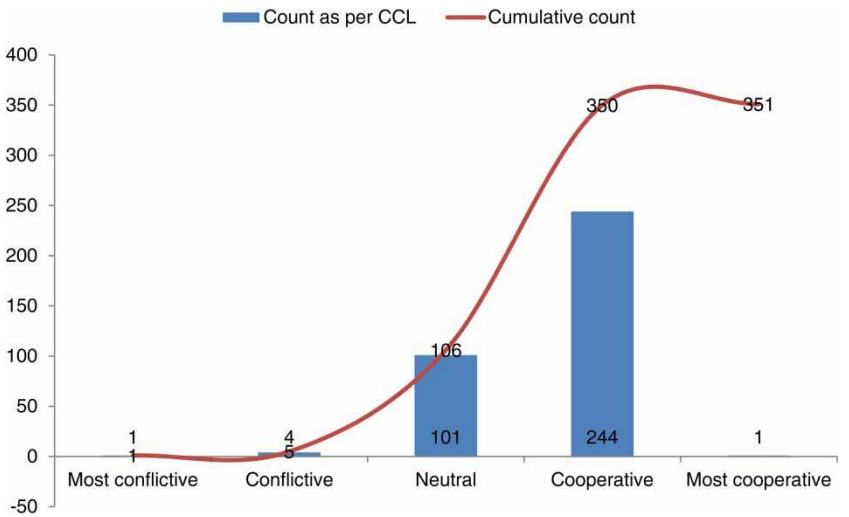

Fig. 3. Total number of events by CCLs.

hydropower (12%), and flood control (6%). It is surprising to note that the issue of water quantity did not have greater emphasis among the events. These findings indicate that India is not only concerned with Nepal's hydropower development or that India is trying to capture the water resources available in Nepal, given that hydropower constituted only 12% of the total events, while joint management was the most discussed issue, at 29%. Joint management of water resources may be justified due to Nepal's lack of technological and financial capabilities.

This helps refute the claims reported in various sections of the media and by some scholars that India is trying to capture Nepal's water resources or that it is largely interested in hydropower development for her own benefits. Of the 43 hydropower events, 13 are related to power trade between the two countries. Nepal's theoretical hydropower potential is 83,000 MW, of which 40,000 MW is technically and

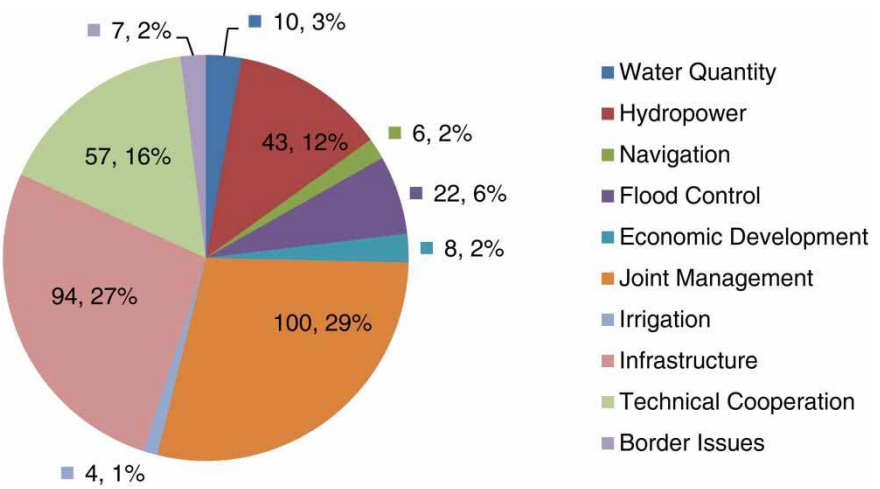

Fig. 4. Total events by issue area. (There were no events recorded for water quality, fishing, or territorial issues.)

economically viable. The installed capacity of Nepal barely exceeds 800 MW. Karnali Chisapani Multipurpose Project (10,800 MW) and Pancheshwar Multipurpose Project (6720 MW) with eight and seven events respectively have not yet seen the light of day. The major issues hampering the development of these projects are cost sharing of different project components and calculation of benefits from the project.

The distribution of cooperative events covered a wide range of issues (Figure 5), but conflictive events were limited to one event each for hydropower, flood control, joint management, irrigation, and economic development; three for technical cooperation; and five for infrastructure. Four of the five conflictive infrastructure events were due to India's unilateral construction of the Tanakpur Barrage on the Mahakali River which led to protests and outcry in Nepal. This indicates that unilateral construction of any infrastructure to control or manage the water resources by any of the participants has the potential to transform into a hotly contested issue in transboundary water management. There were only two extreme conflictive events (−4 to −6), with economic development and infrastructure contributing one each. The extreme cooperative events (4 to 6) involved joint management, infrastructure, hydropower, economic development, water quantity, and technical cooperation (Figure 6).

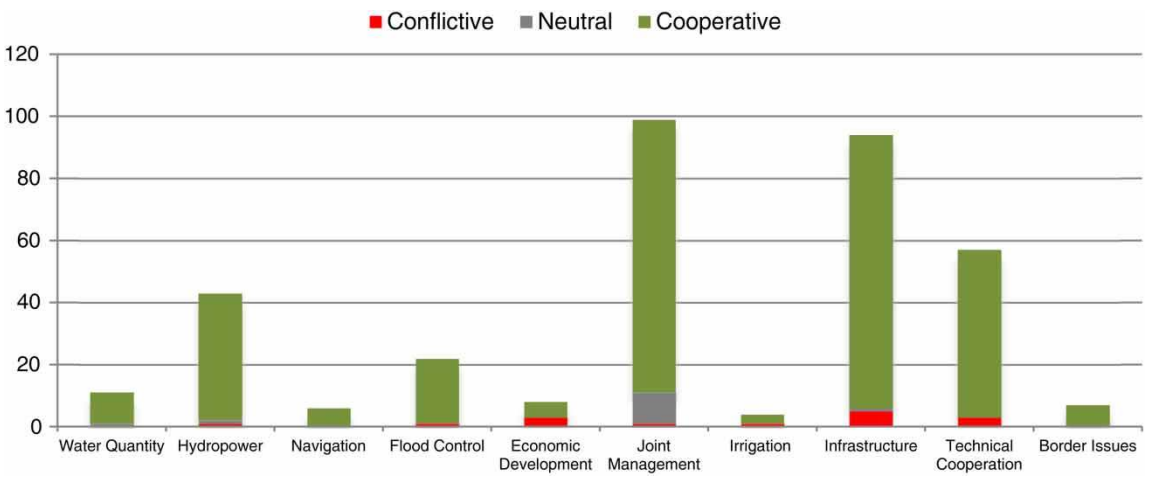

Fig. 5. Cooperative, conflictive, and neutral events by issue area.

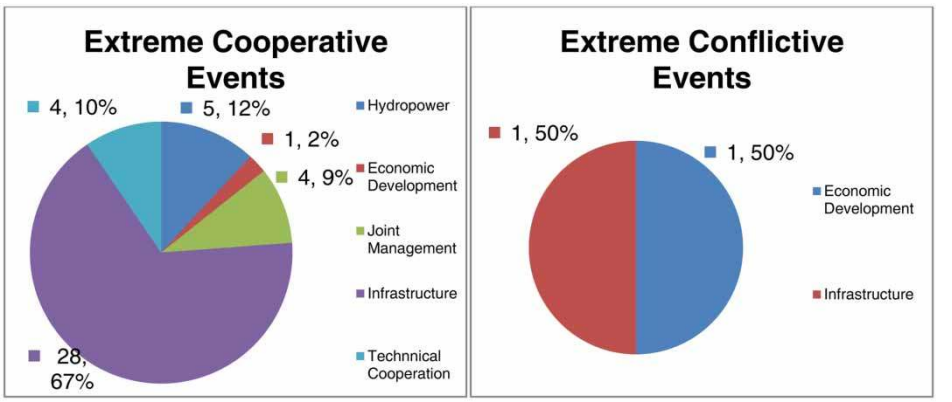

Fig. 6. Extreme cooperative and conflictive events by issue area (BAR scale 4 to 6 and −4 to −6).

The distribution of BAR scale events in the individual issue areas is shown in Figure 7. The issue of infrastructure had the largest combination of BAR scale events (i.e., the issue had a total of eight types of BAR events). Infrastructure BAR scale combinations were closely followed by joint management (seven); technical cooperation and hydropower, each with six, and economic development with five.

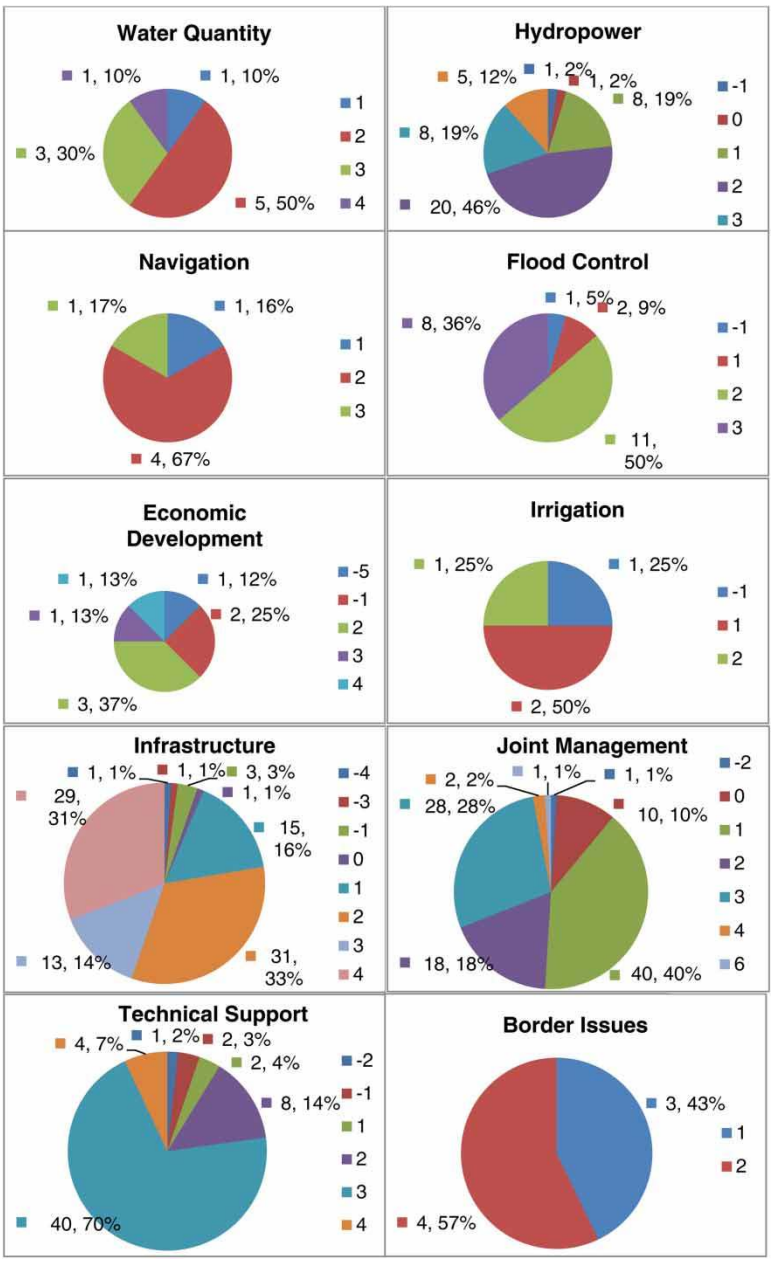

Fig. 7. Distribution of BAR scale for issue areas.

There were few combinations of BAR scales for issues like water quantity and flood control (four each), navigation and irrigation (three each), and border issues (two). The issue of economic development had the most conflictive BAR scale (−5), followed closely by infrastructure, with a BAR scale of −4. Joint management had the most cooperative BAR scale (6).

Nepal is heavily reliant on India especially with respect to economics and trade. This can sometimes bring intricacies between the hydropolitical relations between the two countries, as was the case in economic blockade of 1989. Any kind of economic blockade can plummet the economy of Nepal. This can have long lasting impacts on the hydropolitical relations. Unilateral construction of huge infrastructure for development and management of water resources by India or Nepal can change the dynamics of the water availability. This has the potential to escalate into events of a highly conflictive nature. Instead both the countries should come up with more highly cooperative events especially on joint management of water resources. Joint management can result in win-win situations resulting in all round development of one of the poorest regions of the world.

In terms of variations in the range of BAR scales, economic development had the widest variations, from small-scale military acts (−5) to non-military economic, technological, or industrial agreement (4). Infrastructure followed, with a range from political-military hostile actions (−4) to non-military economic, technological, or industrial agreement (4). These were followed by joint management (−2 to 6), technical support (−2 to 4), hydropower (−1 to 4), flood control (−1 to 3), irrigation (−1 to 2), water quantity (1 to 4), navigation (1 to 3), and border issues (1–2).

This indicates that the issues of water quantity, navigation and border issues had only cooperative events; irrigation with one conflictive event (of scale −1) and the count of such events is low. Thus these issues are less-significant in terms of affecting the dynamics of hydropolitical relations. Economic development too has limited events (only 8) but it has the potential to significantly affect the dynamics of hydropolitical relations. Infrastructure and joint management issues (along with economic development) with wider variations in BAR scales can significantly swing the hydropolitical relations from cooperation to conflict and vice-versa.

4.2. Across time

As noted earlier, the 140-year time period was examined as a whole, then was divided into three time phases and a phase-wise analysis was created.

4.2.1. Timeline. The events plotted with BAR scales along the timeline from 1874 to 2014 are shown in Figure 8. It highlights the finding that most of the events were located in the neutral and cooperative CCLs, while very few were in the remaining CCLs.

Before we move into the details of the events, an overall look at the trend provides particular insights about the regional hydropolitics. The overall trend indicates a continuous slide in the BAR scale, with an average of only 2.08 which indicates official verbal support. This regular slide in the BAR scale illustrates how relations have been deteriorating in recent decades. It also underscores the need for significant steps toward providing a conducive environment for hydropolitics to flourish and move in a cooperative direction.

Discussing each event is beyond the scope of this paper, so a few important ones that have had significant impact have been dealt with in brief. The first agreement between British India and His Majesty's Government (HMG) of Nepal was the Sarada Barrage agreement, signed in 1920, for

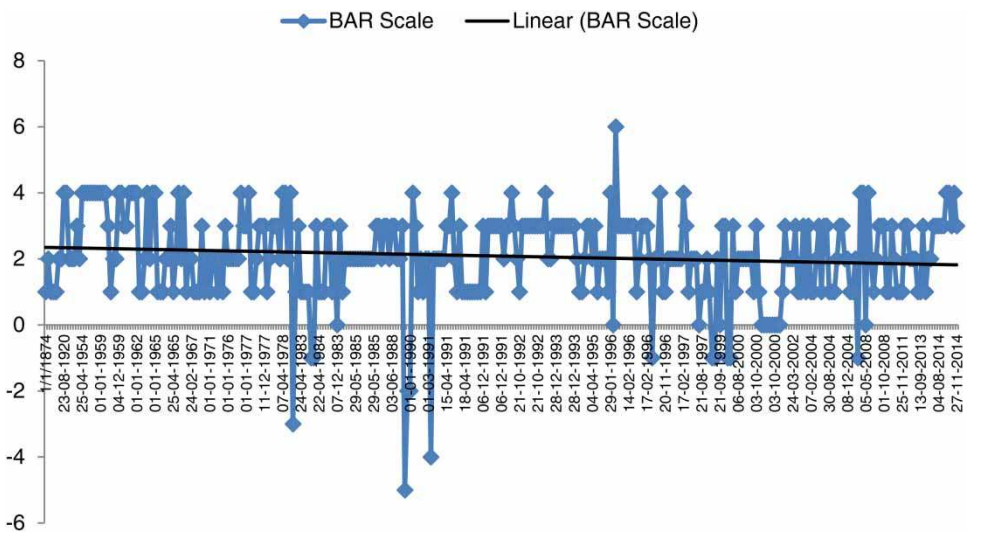

Fig. 8. Movement of BAR scale across the timeline with linear trend line.

harnessing the waters of the Mahakali River. The Kosi Agreement, to tame the Kosi River floods and control the shifting nature of the river through a barrage, was signed in 1954, a few years after Indian Independence. The first instance of cooperation to harness the hydropower potential of Nepal came in 1958 in the form of the Trishuli hydroelectric project on the Gandak River. The Gandak Agreement followed in 1959, for the purpose of constructing a barrage with a view toward enhancing irrigation. The Gandak and Kosi agreements were amended in 1964 and 1966, respectively, to incorporate a few changes in project management, as well as in working terms and conditions.

In 1978, India and Nepal again signed an agreement involving development of hydropower, this time through the Devighat hydroelectric project on the Gandak River. India has been continuously involved in capacity-enhancement initiatives to train Nepali engineers and water professionals; the agreement in 1981 to send 250 engineers from Nepal to India for training on the Karnali project was a significant step. The first conflictive event appeared in 1983, however, when India unilaterally initiated the Tanakpur Barrage on the Mahakali River. Relations between the countries reached one of their lowest ebbs when India imposed an economic blockade in 1989, which ended in 1990. The year 1991 witnessed a huge public outcry and continuing furores in Nepal over the Tanakpur Agreement, even leading to few human casualties. During this time, sentiments in Nepal were against India. But the years after the end of economic blockade saw a large surge in the number of events (Figure 9).

This was because of the unilateral construction of Tanakpur Barrage by India. This pushed Nepal to negotiate comprehensibly with India. In order to normalize relations with India, citing her huge economic dependence, Nepal worked out solutions with India. In the post-1990 period, mega projects such as the Pancheswar multi-purpose project on the Mahakali River, the Karnali Chisapani multi-purpose project and the Sapta Kosi multi-purpose project once again emerged. The result was the signing of the first comprehensive river treaty between the two countries on the development of Mahakali River in 1996; the next year saw an agreement on electric power trade. In 2008, Indian public and private companies entered into hydropower development in Nepal, with two Memorandums of Understanding (MoUs) signed by the GMR-ITD consortium on the execution of the Upper Karnali Hydropower Project

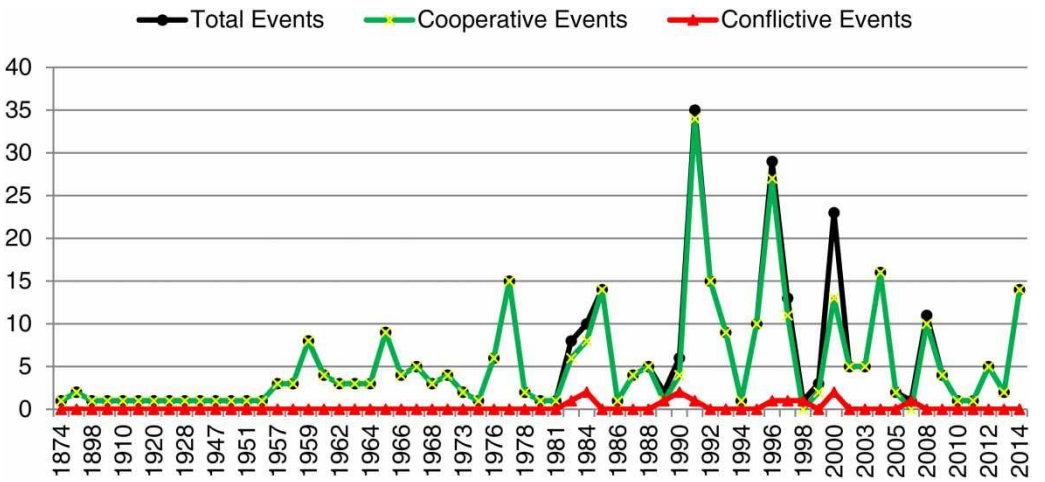

Fig. 9. Distribution of cooperative, conflictive, and total events by year.

and by SJVNL on the Arun III Hydropower Project on the Kosi River system. The same year witnessed a massive flood that caused extensive damage to life and property, and India provided 200 million (20 crores) Indian Rupee as immediate flood relief to Nepal. In 2014, an agreement was signed to increase cooperation in the field of transmission interconnection, grid connectivity, and power trade.

Figure 9 shows the distribution of total, cooperative, and conflictive events by year. As previously noted, there was a surge in the number of events and activities after the end of the economic blockade in 1990, as the two nations tried to normalize their hydropolitical relations. The years 1991 and 1996 saw a high number of events, with discussions surrounding Tanakpur Barrage resulting in the comprehensive Mahakali Treaty. The number of events has decreased since 1996, although there was a slight surge in 2014, due to the recent approach of the Indian PM toward having strong relations with its neighbouring countries. In 1983, the first instance of a conflictive event was reported, while the last conflictive event was reported in 2007. Figure 10 represents the cumulative chart for total, cooperative, and conflictive events. The growth rates for all three seem to have stabilized, more or less, in the last decade or so.

Figure 11 highlights the temporal bias in the data by detailing what percentage of the total events recorded for each year were cooperative. It indicates that the majority of the years had only cooperative events. Of 140 years, there were only 10 years which encountered conflictive events. All these events were observed in the 25-year period from 1983 to 2007 with only one conflictive event in the current century. 1983 witnessed the first conflictive event when India unilaterally started preparations around Tanakpur Barrage on the Mahakali River. It is significant to note that during the years 1998 and 2007, all the events were conflictive in nature: demonstrations were held in 1998 by Nepali communists against India and the government, following the ratification of the Mahakali Treaty in 1996; in 2007, the Nepalese protested an Indian dyke project, as it was considered to flood Nepalese land.

4.2.2. Three time phases. Of the three phases, the BAR scale indicated an increasing trend only for Phase 1 (Figure 12). The trend indicates that hydropolitical relations between British India and HMG of Nepal were moving in the cooperative direction, with the average BAR scale being 2. British India tried to maintain cordial relations with Nepal and informed Nepal of any development in and

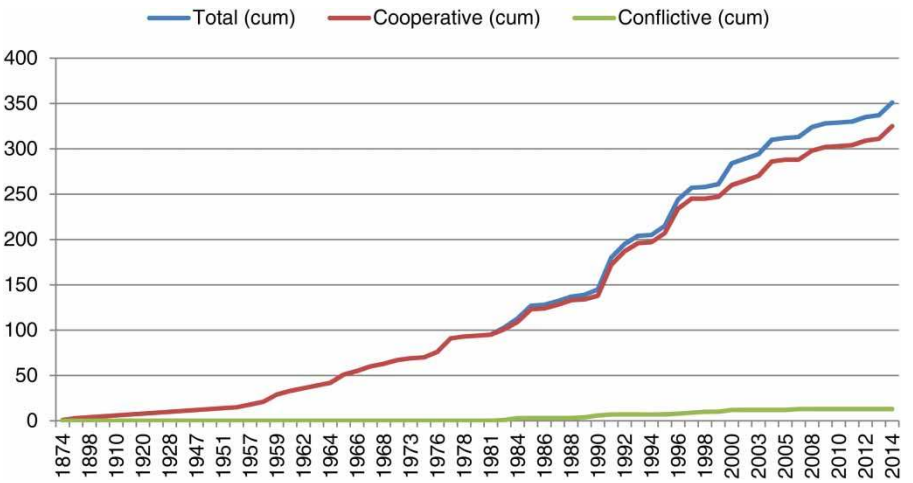

Fig. 10. Cumulative of total, cooperative, and conflictive events.

around the river basin. The Sarada Agreement, signed in 1920, was the highlight of Phase 1. Though the total number of events in this phase was low, there were no conflictive events.

Phase 2 witnessed the worst decline in the BAR scale, as indicated by the steepness of the linear trend line (Figure 13). This phase began on a very promising note, with the signing of major agreements on the Kosi and Gandak rivers. India also assisted Nepal in building irrigation projects to enhance agriculture. But as time progressed, Nepal realized that the benefits expected from the projects were not the benefits actually accruing from the project. Nepal began to perceive that the projects only benefitted India, and that only a small portion of benefits were directed towards them. This led to amendments of the Kosi and Gandak treaties. The end of Phase 2 witnessed the imposition of an economic blockade on Nepal by India, leading to the deterioration of hydropolitical relations to their lowest level. The average BAR scale in this phase was 2.18. Although the average BAR scale increased from that of Phase 1, this phase witnessed turmoil in the countries' relations, with agreements being signed, as well as an

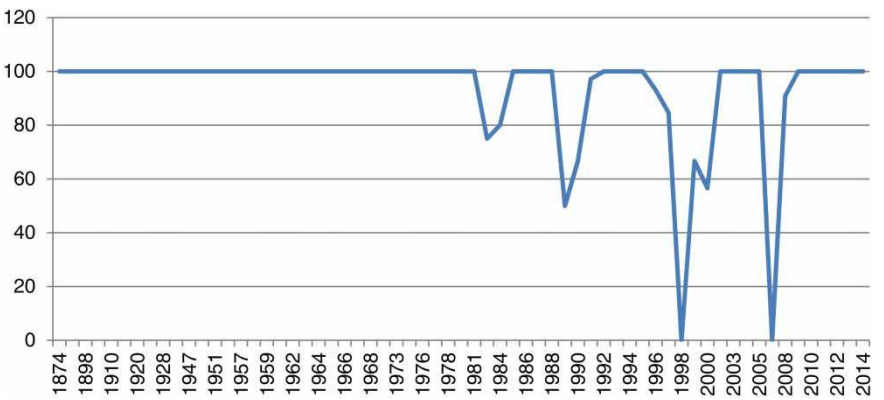

Fig. 11. Cooperative events as a percentage of total events by year.

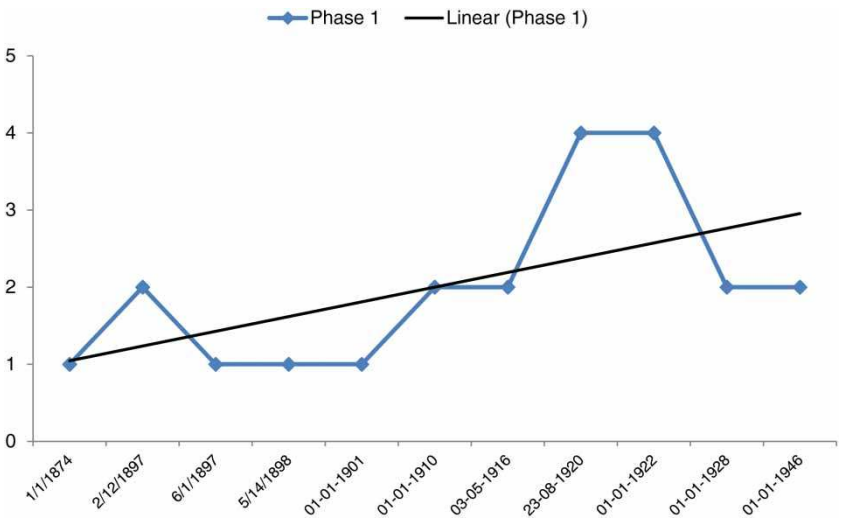

Fig. 12. Movement of BAR scale along with trend line for Phase 1.

economic blockade being imposed. This phase also saw an increase in the number of conflictive events, along with the occurrence of the most conflictive event.

Phase 3 indicates a stagnancy in BAR scale, with a very low rate of decrease and an average of 2.03 (Figure 14). This phase had an increase in the number of conflictive events, as compared to Phase 2,

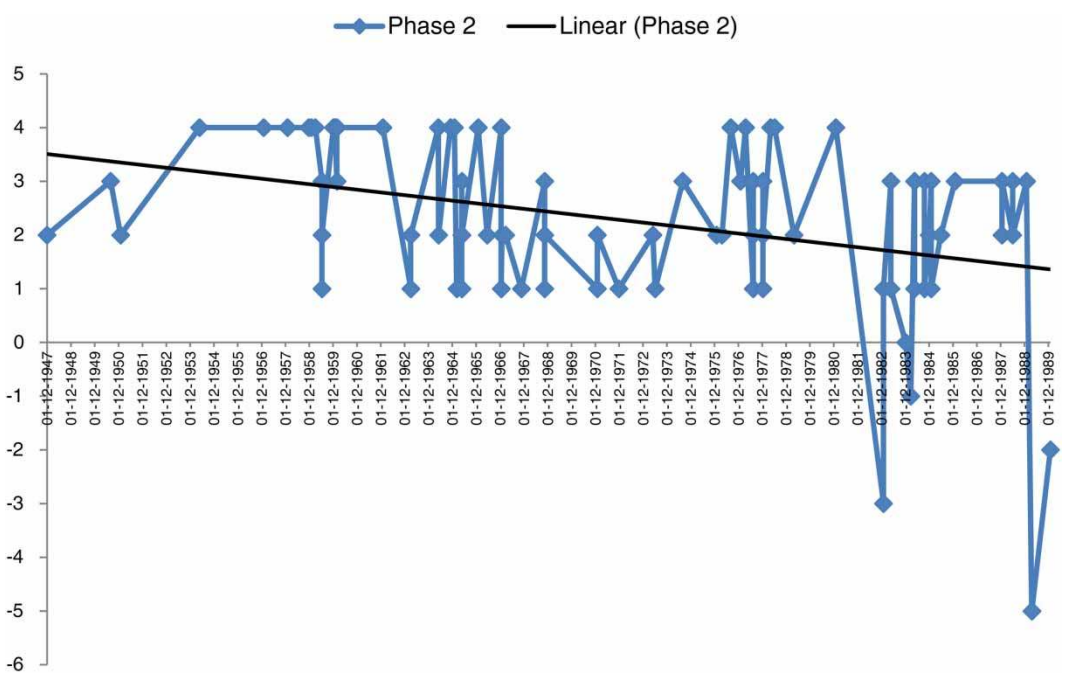

Fig. 13. Movement of BAR scale along with trend line for Phase 2.

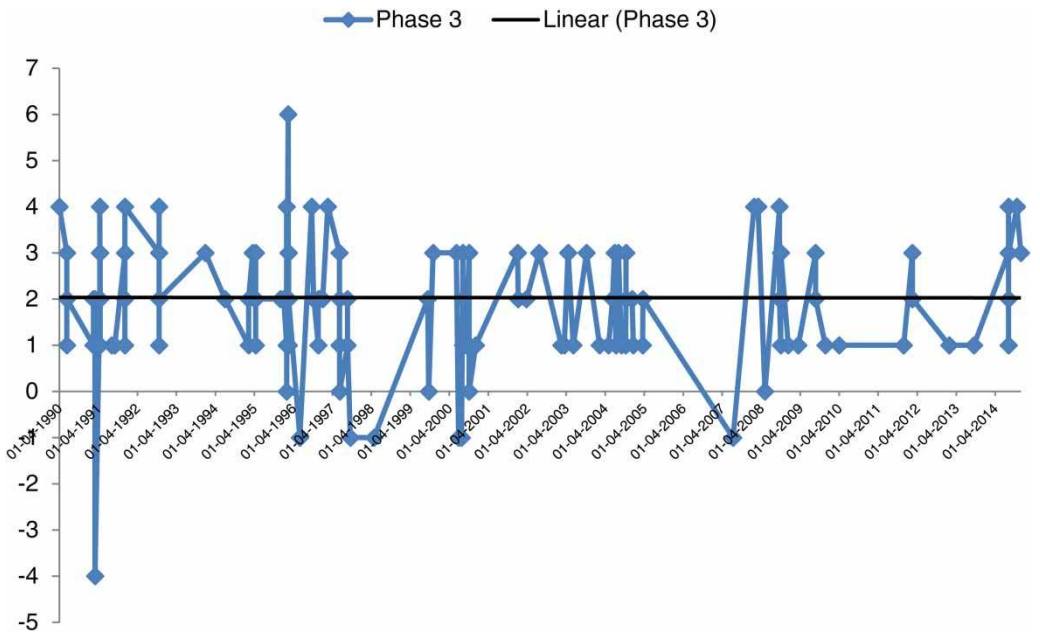

Fig. 14. Movement of BAR scale along with trend line for Phase 3.

though the intensities of the conflictive events were low. This phase boasts the comprehensive Mahakali Treaty as its highlight: this treaty was the most cooperative event of this phase, as well as of the total timeline. There was an increase in the number of events in this phase; the reason for this could be the extensive reporting of events, the growth of electronic and printed databases, or a genuine increase in the interactions between the two nations.

4.3. Across space

A spatial analysis was carried out at the sub-basin level to better understand the relations between India and Nepal at a deeper scale. Events that involved both nations, irrespective of the sub-basin, were considered to fall in the Ganges Basin, as all of the sub-basins constitute the Ganges Basin. The sub-basins considered were the Mahakali, Karnali, Gandak, Kosi, and Mahananda moving from west to east along Nepalese territory. The Mahananda sub-basin was not analysed in detail, as it had only two events. Figure 15 shows the distribution of events across the basins. Most of the events that involved both nations as a whole were included in the Ganges Basin category (154 events, or 44% of the total). Of the four sub-basins analysed in detail, the Mahakali had the highest number of events (62, or 18%) followed by the Kosi with 59 events (17%), Karnali with 45 events (13%), and Gandak with 29 events (8%).

The initial negotiations between British India and Nepal began around the Mahakali River Basin. Immediately after India's independence, the nations negotiated on the Kosi and Gandak projects, which were followed by discussions around the Karnali River Basin. The Mahakali Basin was again the focus when the Tanakpur Barrage project was initiated by India, which concluded in the Mahakali

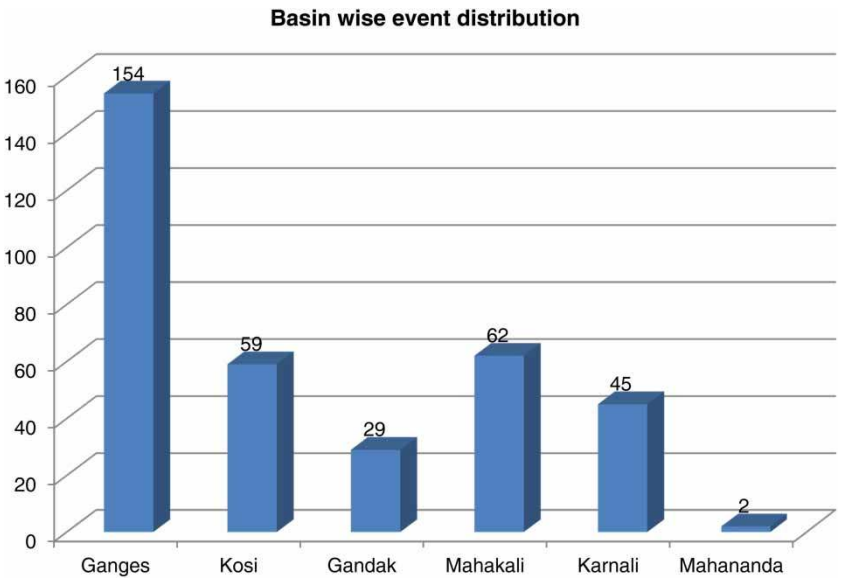

Fig. 15. Distribution of events across the sub-basins.

River Treaty. The recent negotiations involve the Sapta Kosi High Dam project and Sun Kosi Storage-cum-Diversion Scheme on the Kosi River and the Pancheshwar project on the Mahakali River.

4.3.1. Mahakali Basin. Figure 16 displays the total number of events by BAR scale. From a total of 62 events, 59 were cooperative (95%), 2 were conflictive (3%), and the remaining 1 was neutral (2%). The highest share was contributed by BAR scale 2 (24 events), followed by 3 and 1 with 16 and 13 events, respectively. In terms of CCL, the basin was dominated by cooperative events (71%) and neutral events (24%), which indicates moderately positive cooperation, yet without much concrete action. By issue type, technical cooperation had the highest contribution, with 16 events (26%), followed by joint management and infrastructure with 15 events (24%) and 13 events (21%), respectively. Water quantity, hydropower, and border issues contributed six events each (Figure 17). The Mahakali is the only border river between India and Nepal, and it forms the border on the western side. The earliest events in the whole timeline corresponded to border issues with respect to levels of water in three sagars. Only technical cooperation and infrastructure contributed one conflictive event each, with one neutral water quantity event; all of the rest were cooperative events. The total of five highly cooperative events (4 to 6 BAR scale) was distributed between infrastructure (three events) and joint management (two events). There was no extremely conflictive event in the Mahakali Basin. The average bar scale for the basin was 2.11, which was slightly higher than the total average of 2.08.

Figure 18 represents the sequence of events across the timeline from 1874 to 2014, along with the trend line in linear form for the BAR scale. The first available record of negotiations between the two countries happened to be on the Mahakali Basin in 1874, where the parties agreed to maintain the water levels of three reservoirs located on the international border. The first project agreement, known as the Sarada Barrage Agreement, was signed for the Mahakali in 1920. India's 1983 decision to unilaterally build the Tanakpur Barrage was the most conflictive event, with a BAR scale of −3. This basin also has the

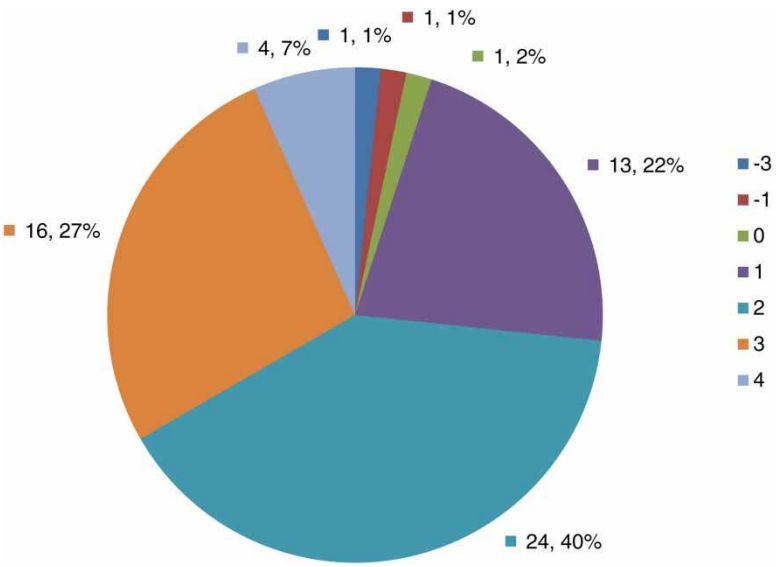

Fig. 16. Number of events by BAR intensity scale for the Mahakali Basin.

only comprehensive agreement between the two countries. The trend line indicates an increasing trend, with a gradual rate of increase. It is the only basin with an increasing trend in BAR scale.

4.3.2. Karnali Basin. Figure 19 shows the total number of events by BAR scale for the Karnali Basin. A total of 45 events were distributed as follows: 41 cooperative events (91%), 3 conflictive events (7%), and 1 neutral event (2%). The distribution of events by BAR scale was as follows: 19 events (42%) for cultural or scientific agreement or support (scale 3); 10 events (22%) for official verbal support (scale 2); 9 events for mild verbal support (scale 1); 3 events for non-military economic, technical, industrial agreement (scale 4); 2 events for mild verbal hostility (scale −1); and 1 event each for neutral and strong

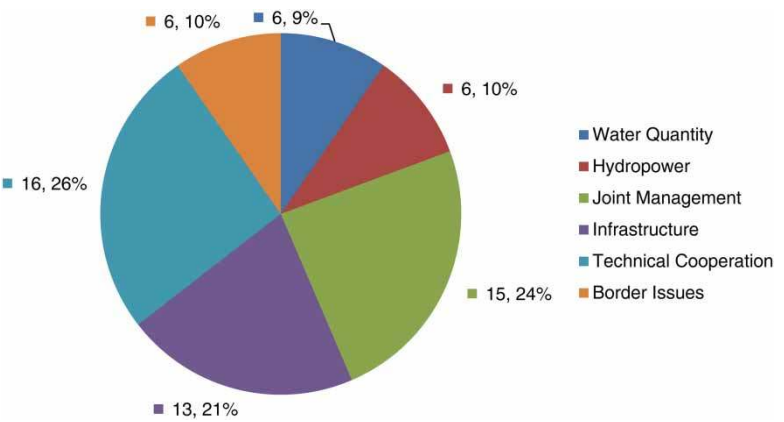

Fig. 17. Number of events by issue type for Mahakali Basin.

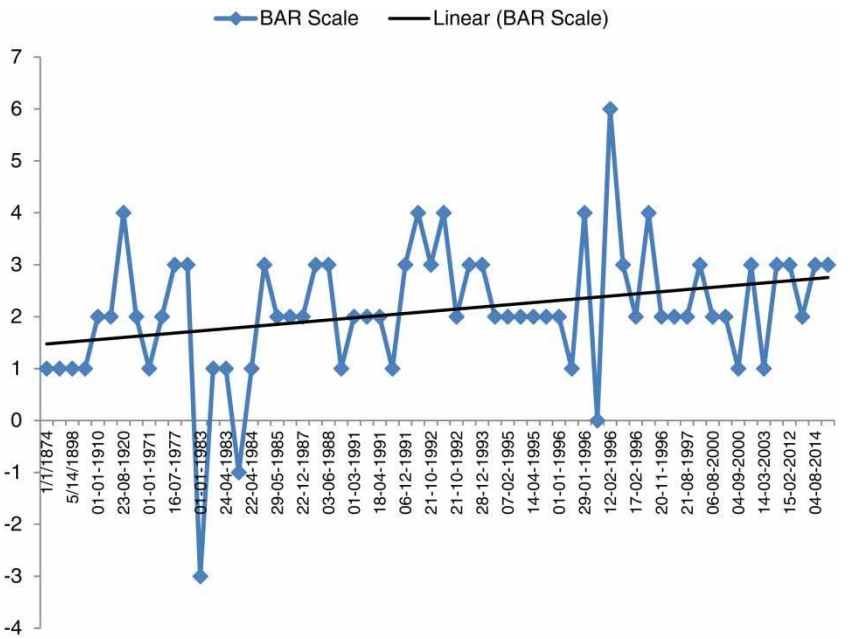

Fig. 18. Movement of BAR scale along with trend line for Mahakali Basin.

verbal hostility (scale 0 and −2, respectively). From the CCL point of view, the basin was dominated by cooperative (71%) and neutral (27%) events, while conflictive events made up only 2%; this indicates a moderately positive cooperation, yet without much concrete action.

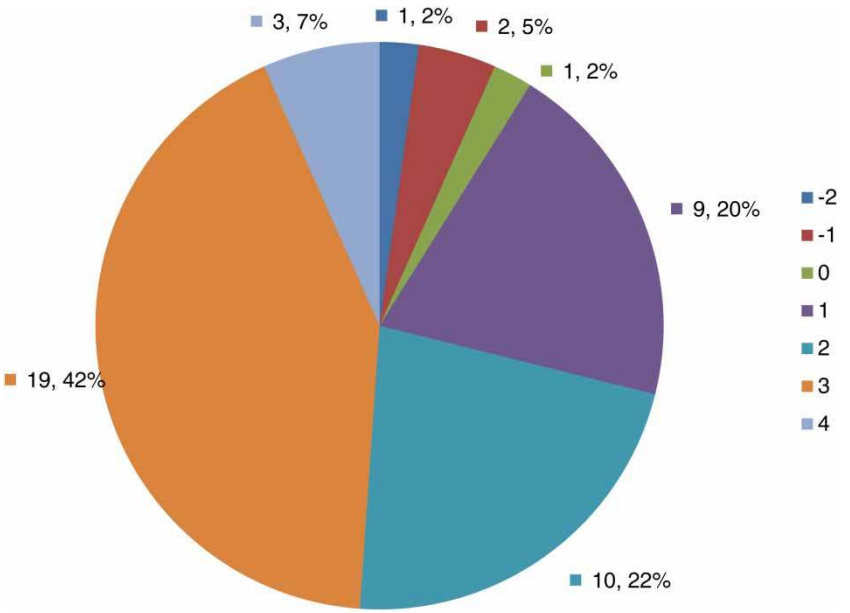

Fig. 19. Number of events by BAR intensity scale for the Karnali Basin.

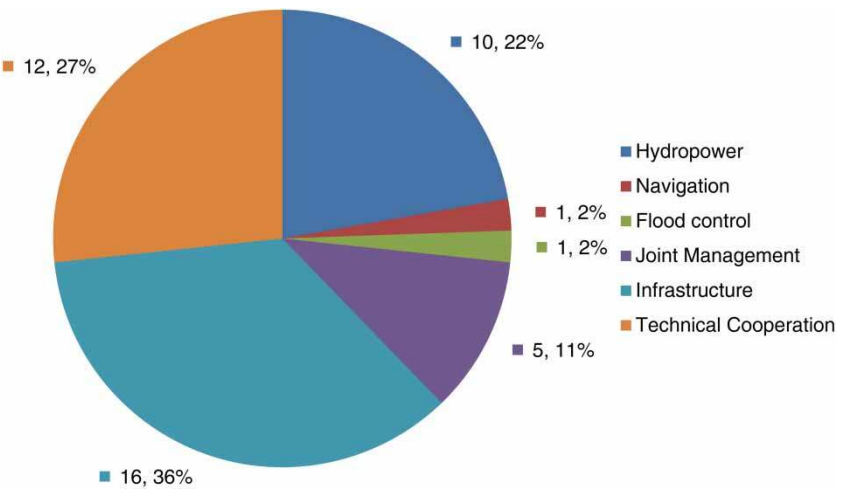

Fig. 20. Number of events by issue type for the Karnali Basin.

When viewed through the lens of issue types, the largest contribution was from infrastructure, with 16 events (36%), followed by technical cooperation with 12 (27%), hydropower with 10 (22%), joint management with 5 (11%), and navigation and flood control with 1 event each (2%) (Figure 20). With 10 hydropower events to its credit, the Karnali Basin had the greatest number of hydropower events among the four sub-basins. The three conflictive events were distributed between technical cooperation with two events and infrastructure with one. There were three highly cooperative events (4 to 6 BAR scale), one each falling under the issues of hydropower, infrastructure, and technical cooperation, and no highly conflictive events. The average bar scale for the Karnali Basin was 2.09, which coincides with the total average BAR scale of 2.08.

Figure 21 represents the sequence of events across the timeline, along with the trend line in linear form for the BAR scale. This basin can claim many hydropower events, from which Nepal can generate cheap renewable energy, but, ironically, no hydropower agreement has been signed between the two nations thus far. They have only been negotiating on various projects, but without fruitful outcomes. The trend indicates a decline in BAR scale with a gradual rate of decrease.

4.3.3. Gandak Basin. Figure 22 shows the total number of events by BAR scale for the Gandak Basin. There were in total 29 events, of which 27 were cooperative (93%) and 2 were neutral (7%). Unlike the Kosi Basin, this basin had no conflictive events. The largest share was contributed by BAR scale 2 (official verbal support) with 12 events (41%), followed by scale 4 (non-military economic, technological or industrial agreement) with 9 events (31%), scale 3 (cultural or scientific agreement or support) with 6 events (21%), and scale 0 (non-significant acts) with 2 events (7%). From a CCL point of view, the basin was dominated by cooperative (93%) and neutral (7%) events, which indicates moderately positive cooperation, yet without much concrete action. Through the perspective of issue type, infrastructure had the highest contribution, with 17 events (59%), followed by technical cooperation with 8 events (28%), joint management (2 events), and hydropower and navigation sharing an event each (Figure 23). There were nine highly cooperative events (4 to 6 BAR scale), all contributed by the issue of infrastructure. The average bar scale for the Gandak Basin was 2.69, which was higher than the overall average of 2.08.

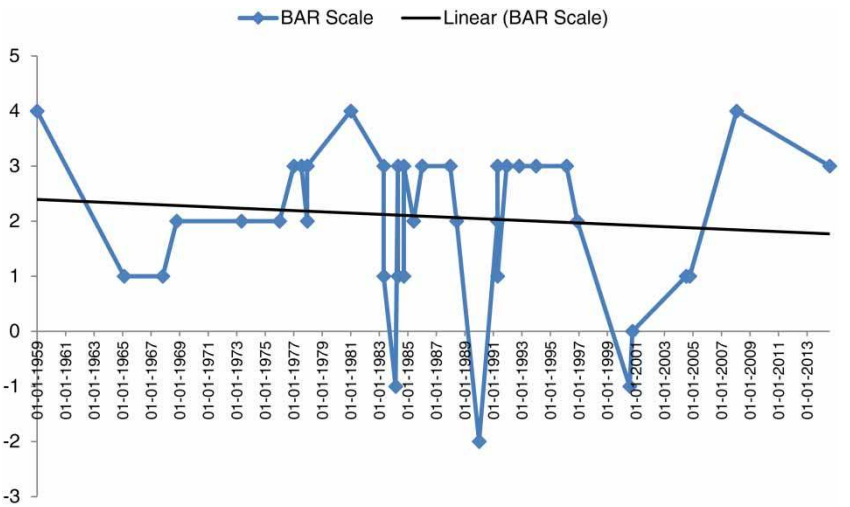

Fig. 21. Movement of BAR scale along with trend line for the Karnali Basin.

Figure 24 represents the sequence of events across the timeline, along with the trend line in linear form for the BAR scale. As previously discussed, both countries signed the Gandak Agreement in 1959, with the view to build a barrage. The agreement was amended in 1964 in order to incorporate the demands and concerns of Nepal. Although the basin has an above average BAR scale, the trend indicates a decline in BAR scale, with a high rate of decrease.

4.3.4. Kosi Basin. Figure 25 shows the total number of events by BAR scale for the Kosi Basin. There were in total 59 events, of which 57 were cooperative (97%) and 2 were neutral (3%). This basin had no conflictive events. The largest share was contributed by BAR scale 3 (19 events) followed by BAR scale 4, 2, 1, and 0, with 18, 15, 5 and 2 events, respectively. From the CCL point of view, the basin was dominated by cooperative (88%) and neutral (12%) events, which indicates moderately positive

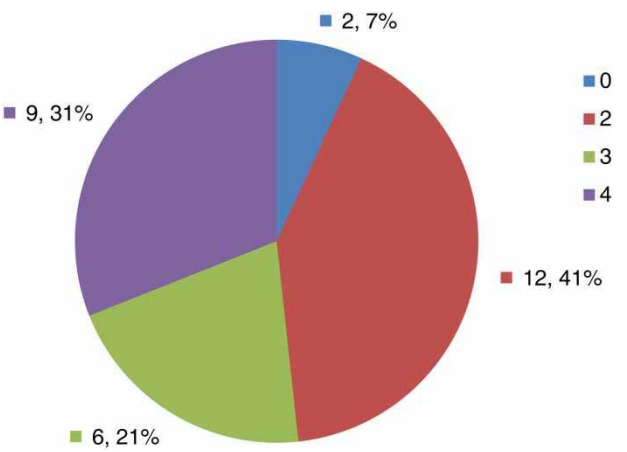

Fig. 22. Number of events by BAR intensity scale for the Gandak Basin.

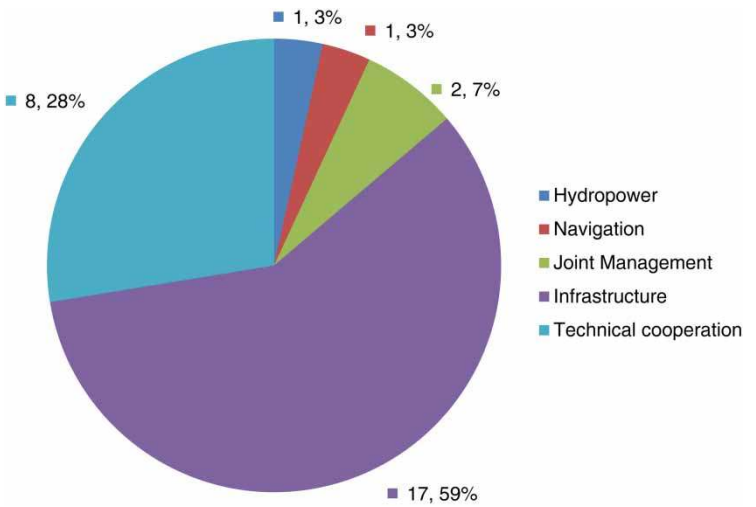

Fig. 23. Number of events by issue type for the Gandak Basin.

cooperation, yet without much concrete action. Through the perspective of issue type, infrastructure made the highest contribution with 28 events (48%), followed by technical cooperation with 18 events (31%). The rest were accommodated between hydropower and navigation, with three events each, flood control and economic development, with two each, and joint management, with one (Figure 26).

The Kosi River has one of the highest sediment loads in the world and is known for frequent changes in flow paths. It often causes devastation due to floods in the Terai region of Nepal and the state of Bihar in India (because of this, the river is known as the 'Sorrow of Bihar'). Many structural measures have been suggested for this river, with the latest one being the Sapta Kosi High Dam project, which has been under negotiation for the past three decades or so. In this basin, there were 18 events that were highly cooperative in nature (4 to 6 BAR scale), the distribution of which was 14 events for infrastructure, 2 for technical cooperation, and 1 each for hydropower and joint management. The average BAR scale for the

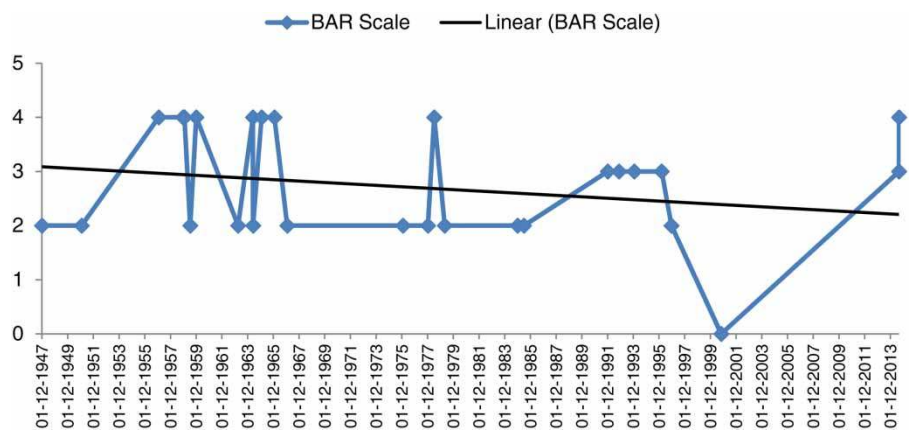

Fig. 24. Movement of BAR scale along with trend line for the Gandak Basin.

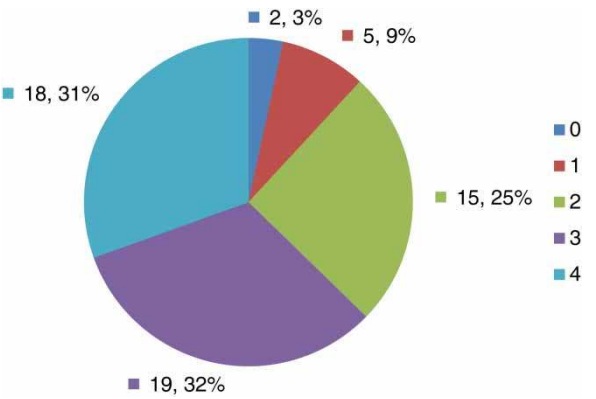

Fig. 25. Number of events by BAR intensity scale for the Kosi Basin.

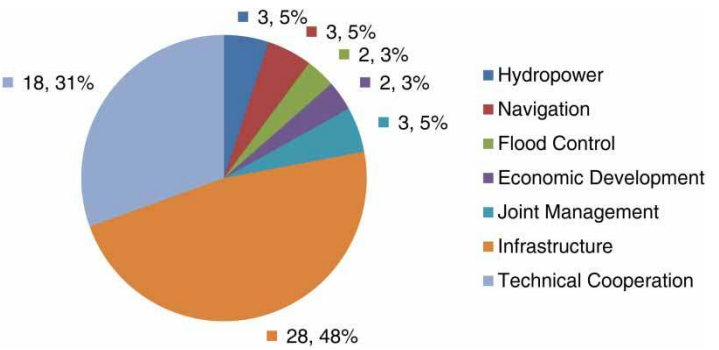

Fig. 26. Number of events by issue type for the Kosi Basin.

Kosi Basin was 2.78, which is higher than the total average of 2.08 and is also the highest BAR scale among the four sub-basins.

Figure 27 represents the sequence of events across the timeline, along with the trend line in linear form for the BAR scale. This basin boasts the many irrigation projects that have helped both India

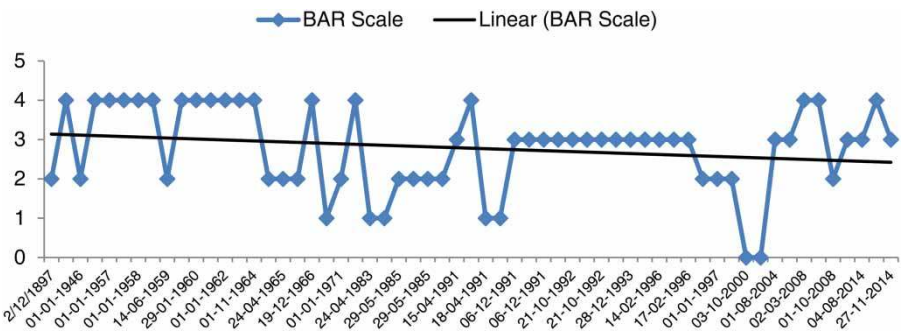

Fig. 27. Movement of BAR scale along with trend line for the Kosi Basin.

and Nepal develop their irrigation potential. In terms of area irrigated, India has a greater advantage, but Nepal too has some share of the irrigation benefits. India has developed many small irrigation projects in Nepal. The problem of flooding continues to be jointly tackled. The first agreement between these countries after India's independence was the Kosi Barrage project in 1954, which was later amended in 1966. The barrage has exceeded its useful lifespan, and so both countries are negotiating the high dam project in order to provide a long-term solution for flood control and to generate other benefits as well. Though the basin showed an above average BAR scale, the trend indicates a decline in BAR scale with a high rate of decrease.

5. Conclusions

The data assembled are a sampling of the types of information that can be culled from the BAR event database. Gathered from a wide range of sources, this database represents a unique resource. The analyses have been carried out at spatial and temporal scales, as well as by issue area and intensity of conflict or cooperation. This study employs the methodology with a specific regional research, by expanding the database into bi-national water events and exploring events where water was involved. The conflict/cooperation scale has been successfully employed to understand the bi-national hydropolitics between India and Nepal, which share the complex Ganges river system. This study provides insights about how the hydropolitics has been shaped and reshaped with time.

India and Nepal have seamlessly bonded, geographically, culturally and economically over the decades. India has always wanted to be the caring, doting elder brother to Nepal. The two countries cemented their close ties in 1950 with the Indo-Nepal Treaty of Peace and Friendship that allowed near equal rights to residents of both the countries in the neighbour's territory. It was meant to ensure everlasting peace and friendship, keeping the two Hindu-majority countries permanently locked in a warm embrace. But many political parties in Nepal, and their followers, were not so gung-ho about the bhai-bhai bon-homie. The favours guaranteed to Indians through the bilateral treaty were seen as a threat to Nepal's sovereignty, it led to fears of gradual Indianization of the Himalayan Kingdom. Since then, the original treaty has always been a subject of debate with the Maoists even demanding that it be scrapped.

The results of this study should help in gaining deeper insights about the Indo-Nepal hydropolitical relationship. The hydropolitical relationship between the two countries is cooperative in nature which is indicated by the average BAR scale of 2.08 highlighting official verbal support between the two countries. This is supported by the CCL analysis, which indicated moderately positive cooperation, yet without much concrete action. The same was true for the sub-basins as well, with more than 90% of events being cooperative and the rest being neutral and conflictive.

The concern that India is largely interested in Nepal's hydropower resources appears to be unfounded, given that the issue of hydropower constituted only 12% of the total events. The issue of joint management topped the chart with 29% of the events, followed by infrastructure and technical cooperation, with 27% and 16%; hydropower was fourth. Even in the sub-basin analyses, none of the basins indicated bias towards hydropower. The issues of technical cooperation and infrastructure were highly emphasized in the sub-basins, as well. This indicates that both countries accord joint management of natural resources utmost priority, while in keeping with their own interests. To date, the issue of water quality has not

been discussed, and the issue of water quantity is seldom discussed, but with water resources getting scarcer, these two issues may gain prominence.

The major reason for very low hydropower potential being tapped so far is because there appears to be a wide gulf in the priorities of the two countries. Differences appear in the projects to be taken up with priority and sharing of project benefits. Nepal was quite keen on initiating the Karnali project (10,800 MW) while India wanted to take up the Pancheshwar project (6,720 MW). Both these projects need to be fast tracked as they have the potential to transform Nepal into a power surplus state leading to huge economic progress of the region.

For better transboundary cooperation both the countries should shy away from unilateral infrastructure development, rather preferring joint water resources development and management. A framework agreement regarding the development and management of natural resources, especially transboundary waters, should help. Both the countries should take into consideration each other's national interests. This should be at every stage of negotiations of project inception, explorations, design finalization, execution and management of infrastructure, project sites and other related infrastructure.

Nepal has so far benefitted from the projects, be it the Kosi Agreement or Gandak Agreement or various hydropower and infrastructure projects, etc. The total irrigated command area from the Kosi project/barrage in Nepal is 24,480 ha and from the Gandak project is 57,900 ha. Nepal also received hydropower and flood control benefits from these projects. But a certain section in Nepal believe that the benefits are heavily tilted in favour of India. This is one of the major reasons for the lack of progress in hydropolitical cooperation during the last few decades. Nepal can learn from past experience how to extract the most out of any agreement with India without hampering her national interest. Nepal should enhance the negotiation capabilities to put national interests on the negotiation table with authority.

Of the four sub-basins, the Mahakali had the highest number of events (62, or 18%) followed by the Kosi with 59 events (17%), Karnali with 45 events (13%), and Gandak with 29 events (8%). The Kosi Basin had the most cooperative relations, with the highest average BAR scale and the highest percentage of cooperative events, along with no conflictive events. After the Kosi were the Gandak, Mahakali, and Karnali basins. An increasing trend was visible only in Phase 1 (i.e., during British India) and for the Mahakali sub-basin. The remaining phases and sub-basins exhibited a decreasing trend in the BAR scale, as did the overall trend covering the entire timeline. The increasing trend in British India was because they consulted with Nepal before going ahead with any project and did not take up any action/activity/project unilaterally. For the Mahakali sub-basin, it was due to the only comprehensive agreement signed between India and Nepal – which involved numerous stages of negotiations. The declining trends of the overall and sub-basin BAR scales are a concern for both countries. Immediately after India's independence, there was a surge in hydropolitical cooperation with Nepal. But the provisions in the Kosi and Gandak agreements hurt the hydropolitical relations the most; the impacts of which can still be felt. The agreements gave rise to sovereignty and autonomy concerns in Nepal. The perception of inequitable sharing of project benefits adds to the concerns of Nepal.

But the two countries need to recalibrate their positions. The Ganges Basin riparians need to understand the gravity of the situation and take significant steps to jointly work towards the socioeconomic development of the region. Nepal should maintain cordial relations with India. Nepal's economic dependence, was in fact reinforced during the economic blockade. India too needs a friendly Nepal, whose

geopolitical importance due to the open border between the two countries cannot be overstated. It is also in India's interest that there be political stability in Nepal, to prevent the spill-over effect any turmoil can have for the bordering States of Bihar and Uttar Pradesh.

Comprehensive river treaties were lacking; rather only specific project agreements have been signed. This means that the maximum potential between the parties has not been realized. The bilateral approach followed by India is one of the factors affecting hydropolitical relations. India believes in project specific agreements and not an integrated water management approach which significantly reduces the benefits of cooperation. The lack of more cooperative events (events with high BAR scale) is counterproductive. Lack of trust between the two countries is one of the reasons for it. Perceived risks of cooperation could be another factor that hampers the hydropolitical relations between the two countries. But this needs to be explored in future studies. Future studies should also be taken up to ascertain the reasons for lack of trust between India and Nepal.

Natural disasters have the potential to bring the two countries closer as in 2008; after the Kosi floods both the countries initiated negotiations after a gap of four years. It was again seen recently in the aftermath of the massive earthquake in Nepal in 2015 where India was the first country to send relief and aid. The spontaneous outpouring of grief and support among Indians for Nepalese was natural. It was a reflection of how Indians see the Nepalese: less as neighbours and more as an extension of the great Indian Parivar. The public reaction in India shows that Indians still continue to have a little bit of Nepal in their DNA.

Both nations must come forward and take concrete actions that will generate opportunities for more cooperative events that have visible results. The findings of this study underscore the need for significant steps toward providing a conducive environment for hydropolitics to flourish and move in a cooperative direction. Both the countries should move ahead from official verbal support to major strategic alliance, such as the International Freshwater Treaty, through cooperative projects for watershed management, irrigation, and poverty alleviation. India should take up confidence-building measures not limited to capacity development programmes, joint investigations of projects, and data and information sharing to build trust. Apart from this, India should also undertake risk reduction strategies to cut down the perceived risks of cooperation where they exist.

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Received 24 May 2016; accepted in revised form 24 March 2017. Available online 20 May 2017