

# Framing the Brahmaputra River hydropower development: different concerns in riparian and international media reporting

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## Abstract

Development of the Brahmaputra River, which links China, India and Bangladesh, has been hindered by significant challenges, particularly political challenges. News reports can mirror the perceptions of political actors, but are, owing to the complexity of the issue, complicated and unstructured. We present a comparative content analysis of the overall framing in news reports of the Brahmaputra River development from major English news media. A structural topic model is established to discover latent topics in the corpus of 1,569 news articles published in 34 countries or regions. We find that politics, including domestic and international politics, dominates the news narratives. Environmental issues, such as glacier status and climate change impacts, are secondarily discussed. Technology and economy issues are less frequently presented in the media coverage. Advantages of upstream countries and dependences of downstream countries are reflected in news reporting and explicitly emerge in the structural topic model. These findings and implications are important for promoting mutual understanding and cooperation among riparian countries in developing the Brahmaputra River. The proposed approach is expected to be widely used as a methodological strategy in future water policy studies.

*Keywords:* Brahmaputra River; Hydropower development; News framing; Topic modeling; Transboundary river management

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## 1. Introduction

Numerous studies highlight the need for analyzing the propensity for conflict or cooperation along international rivers to better understand potential socio-political threats (Wolf *et al.*, 2003; Espey & Towfique, 2004; Biba, 2014). As a large international river, the Brahmaputra (called Yarlung Zangbo in China) is increasingly attracting the eyes of analysts in today's world. The Brahmaputra is the largest (by annual discharge) of the three rivers in the Ganges–Brahmaputra–Meghna (GBM) system, and by itself carries more flow than all but four rivers in the world (Ray *et al.*, 2015). The

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Brahmaputra originates from Tibet (China), and flows through China, India and Bangladesh successively, emptying into the Bay of Bengal. The three riparian countries, China, India and Bangladesh, are the world's first, second and eighth most populous countries, respectively (Ahmed *et al.*, 2013), with about 130 million people living in the Brahmaputra River basin. In addition, all three countries face severe problems of water scarcity and steeply rising demands for power generation, particularly under present climate change (Grafton *et al.*, 2014). Considerable divergences of opinion on the development of the Brahmaputra exist among the three demographic giants, especially between China and India (Zawahri, 2008; Biba, 2014). The mixture of regional political and environmental aspects makes the issue complex and tough.

News media reporting can mirror the perceptions of public and political actors. The public rely heavily on news media to help understand many complexities relating to natural resource and environmental issues. Hence, news media play an important role in both reflecting and shaping public opinions around key issues (Miles & Morse, 2007). Meanwhile, by affecting the policy agenda or by providing a public sphere for deliberating and legitimizing specific policy alternatives, news media significantly influence the formation of policy alternatives (Steffek, 2009; Kleinschmit, 2012). Specifically, with regard to international river issues, news media in riparian countries can reflect their policies, plans and actions on developing the river, and their attitudes towards conflict or cooperation. Hence, riparian countries can better understand their neighbors' interests by analyzing related news articles. In addition, news reporting from non-riparian countries can reflect the international public opinion on river development issues. The international public opinion may be more objective and neutral, and is also important in resolving conflicts and forming a cooperation framework (Sadath *et al.*, 2013).

The Brahmaputra River basin is suffering from climate-driven impacts, with implications for national security (Dinar, 2014), which creates obstacles to cooperative agreements on the sharing of the transboundary water resources (Shimray, 2004; Barnett, 2009; Malone & Mukherjee, 2010). Development of the Brahmaputra mainly involves two aspects, namely water diversion and hydropower, and the latter is more urgent at present (Biba, 2014). Since China started to construct hydropower projects on the mainstream of the Brahmaputra in 2010, disputes on this transboundary river have become more intense among the riparian countries as well as the entire world. This study analyzes the news reporting of the Brahmaputra hydropower development issue to help better structure and understand the disputes. In particular, we examine different countries' news media frames on the issue by using a computer-assisted text-mining approach. We identify the major frames of the issue and their divergences among different countries. We discuss the results and draw implications from this analysis for promoting cooperation in developing the Brahmaputra and for enlightening other international river basin regions in dealing with similar issues.

## 2. Theoretical background

### 2.1. Theoretical concept of framing

As news is a socially and politically constructed product, it is influenced by a process of cognitive simplification called framing (Jang, 2013). According to the definition given by Chong & Druckman (2007), 'framing theory is that an issue can be viewed from a variety of perspectives and be construed as having implications for multiple values or considerations'. In present journalism, framing is identified

as an organizing principle for news writing and aims at helping audiences make sense out of information by categorizing and interpreting certain events into different perspectives (Gamson & Modigliani, 1989; Entman, 1991; Pan & Kosicki, 1993). With regard to an event, frames highlight some pieces of information and understate others (Entman, 1993).

The news media are an important source of information and opinions for the public with the power to give specific meaning to certain events. Political actors regard the news media as an effective way to express their opinions on domestic or international political issues. According to Perri 6 (2005), political actors can use framing to organize experience and produce a bias for action. The former means that frames enable people to know what is going on, or define boundaries of an event; and the latter means that frames shape people's views on an event by calling for specific styles of thinking or of action responses. In this study, identifying national interests of and policy responses to the Brahmaputra hydropower development issue would require both functions. Hence, framing analysis is a good tool for performing the task.

Journalists rely on frames to assess the potential newsworthiness of an issue to the audience. At the very beginning of reporting an issue, journalists often have many frames to shape the reporting. However, with time, the frames that resonate with dominant values or ideologies will have a better chance of remaining in the media coverage and will become the dominant frames in certain social contexts (Gamson & Modigliani, 1989). Hence, in a media system of a given country, frames that conform to national interests or resonate with the dominant ideology of that country will eventually predominate in the country's media coverage. Consequently, we can use framing theory to detect stakeholder countries' national interests of and policy responses to the transboundary river issue.

In previous studies, framing theory has already been used in analyzing such issues of conflict, especially those involving environmental or political complexities. For instance, Sadath *et al.* (2013) identify significant divergences between national and international media in framing the human–tiger conflict in Bangladesh. Jang (2013) investigates the overall framing of the Six-Party Talks on the North Korean nuclear issue in the USA, North Korea and South Korea news media. The framing analysis explicitly reflects national interests and dependences of the three countries on that issue. Shang *et al.* (2015) and Xiong *et al.* (2016) use content analysis to investigate the framing changes of water issues in Chinese mainstream newspapers with a time period of several decades. Previous studies have also investigated the geopolitical game of developing the Brahmaputra River among riparian and other stakeholder countries (Brichieri-Colombi & Bradnock, 2003; Zawahri, 2008; Rahaman & Varis, 2009; Ahmed *et al.*, 2013; Biba, 2014). However, framing theory is seldom employed in analyzing this issue, although the Brahmaputra River basin has continuously attracted the attention of the world's media during these years.

## 2.2. Framing analysis based on structural topic modeling

From a formative perspective, news frames are constructed based on a coherently semantic structure of particular shared meaning (Tuchman, 1978; Entman, 1993). Hence, it is possible to identify major frames by analyzing discriminating terms and their clustering in news texts. Previous studies have demonstrated that computer-assisted text-analysis methods can efficiently detect frames in a large corpus of news texts (Jang, 2013; Giorgi & Weber, 2015). In this study, the structural topic model (STM) (Roberts *et al.*, 2014) is used. STM is a statistical model for revealing the intellectual structure of a large corpus and has been used in analyzing political or environmental issues (Lucas *et al.*, 2015;

Tvinnereim & Fløttum, 2015; Jiang et al., 2016). STM induces topics that comprise semantically coherent terms from a corpus. Any article in the corpus is a distribution on the induced topics. For a news article, the dominant topics induced by STM can be regarded as major frames of the article (Giorgi & Weber, 2015). In addition, STM can calculate effects of extra variables on topic prevalence. For a news corpus with information of publication country, STM can identify topic divergences, i.e. framing divergences, in different countries. Hence, STM is an effective tool for this study.

A major methodological problem of this study is the selection of the data source, in other words, the selection of the language of news articles. As performing structural topic modeling with multi-lingual texts is of no significance, and translating thousands of articles to unify language type is also impractical, we choose English news articles as the primary data for the framing analysis. English is the subsidiary official language in India and is extensively used in business, administration and other formal occasions in India. Hence, English news articles published in India are representative data for this study. In addition, English is the most common language in international communication. Major international newspapers, such as the *New York Times*, the *Financial Times* or the *Guardian*, which can tap news sources and attract audiences beyond national boundaries, are mainly published in English. News articles published in these international newspapers are included in this study. English is not frequently used in China and Bangladesh. However, these two countries also have their English newspapers, such as *China Daily* (China), *Shanghai Daily* (China), *The News Today* (Bangladesh) and *The Financial Express* (Bangladesh). These English newspapers target an international audience and are often regarded as a guide to government policies for foreigners (Curtin, 2012). Hence, frames of news articles published in these newspapers can mirror national interests and policy responses that China or Bangladesh would like to present in the international public sphere.

### 3. Context of the case

There is a huge potential in the Brahmaputra River basin for development of water supply, hydro-power and management of the risks of floods and droughts. The riparian countries have planned to put the Brahmaputra water resources to greater use.

To India, the Brahmaputra is of special importance for two reasons: first, the Brahmaputra, accounting for 29% of the total runoff of India's rivers, is the key to India's River Linking Project, which aims to cope with the spatial variability in India's water supply (Misra et al., 2007); and second, the Brahmaputra basin possesses about 44% of India's total hydropower potential, most of which is still undeveloped. Hydropower, as a clean and low-cost energy source, plays an important role in ensuring electricity supply and reducing emissions for India's present society (Rahaman & Varis, 2009).

However, Indian hopes may be significantly impacted by China. As the upstream country, China always has the initiative in the game of sharing the river. In reality, China also casts its eyes on the Brahmaputra for water diversion and hydropower development purposes, and certain actions have been taking place ahead of India. According to China's Twelfth Five Year Plan on energy development, China plans to build five major dams on the middle reaches of the Brahmaputra mainstream from 2010 to 2021. The first of them, the 510-megawatt Zangmu hydropower project, was completed in 2014. The five projects have a total capacity of 3,000 megawatts, accounting for about 3% of the whole hydropower potential of the Brahmaputra. This makes India worry more about China's further action on the so-called 'Great Bend' or 'Great Canyon', a deep gorge across the eastern extremity of

the Himalayas, where the Brahmaputra suddenly curves south onto India's Assamese plain. If the 38,000-megawatt hydropower station near Motuo is built, 'China will gain significant capacity to control the Brahmaputra's flow. Basically, India will become dependent on China for flow of what is now a free-flowing international river' (Grafton *et al.*, 2014).

In addition, China's water diversion project, the South-to-North Water Diversion Project (SNWDP), is already under way. If the Brahmaputra is included in the extended version of the still-pending western route of the SNWDP, the downstream countries, including India and Bangladesh, might suffer greatly from the significant decrease of water supply.

Bangladesh, as the most downstream country in the Brahmaputra River basin, with little political voice and valueless bargaining collateral in the water game, is extremely vulnerable to most unilateral actions by upstream countries. In addition, Bangladesh is heavily dependent on upstream countries for collecting and delivering hydrological data, otherwise it cannot prepare for seasonal floods and droughts, or formulate its domestic water budget, which can lead to great losses. To sum up, the major two players in the Brahmaputra water game are China and India.

Although the benefits of cooperative management of transboundary river development are acknowledged by the international community (Giordano & Wolf, 2003), to date, no multilateral international treaty has been established for the Brahmaputra River basin. China is at the most upstream of the river and has the most military and economic power among the riparian countries. Hence, China is regarded as the upstream 'hydro-hegemon' in the river basin (Zeitoun & Warner, 2006), and would be undeterred from taking unilateral actions, such as dam building and water diversion, which may harm the interests of downstream countries. In recent years, India and China have been in fierce competition in the development of hydropower and water diversion in the absence of cooperative agreements. It is possible that significant conflicts may occur. Understanding national attitudes and interests of stakeholder countries on this transboundary river issue is the key to better solve the problem. Hence, an important theoretical and empirical agenda is to examine how China, India, Bangladesh and other related countries think about the Brahmaputra hydropower development issue. In this study, we implement the task through a framing analysis of English news articles from different countries.

#### 4. Methods

The news articles were collected from an English news database provided by LexisNexis, which is a world-famous database providing computer-assisted legal research as well as business research and risk management services. The news database records full-text English news articles from over 6,000 newspapers all over the world and is one of the most widely used news archives in social science research (Weaver & Bimber, 2008; Racine *et al.*, 2010). Data collection took place on 16 September 2015. Any English news article containing 'Brahmaputra' and 'hydropower', or any synonym such as 'Yarlung Zangbo', 'hydroelectric', 'hydroelectricity' and 'water power', in the main body was collected. The earliest news article provided by the database was published in 1979. Meta data, including publication date, text length and article source, were also obtained from the database. Publication country of each article was annotated manually based on checking the corresponding article source.

All texts and meta data were processed by using the STM package in R (Roberts *et al.*, 2014) to generate topic models where each article was assigned proportions of each topic. The authors qualitatively determined the number of topics and translated modeling results into practical significance.

In STM, a data set of documents can be summarized as a couple of topics. A topic is a distribution on a vocabulary, and a document is a distribution on topics. For example, an article related to hydrological analysis of a transboundary river may have three topics, including ‘transboundary river’, ‘hydrology’ and ‘time series analysis’. The ‘transboundary river’ topic may have words related to transboundary river, such as ‘transboundary’, ‘river’, ‘cooperative’, ‘conflict’ and ‘management’, with high probability; the ‘hydrology’ topic may have words related to hydrology, such as ‘runoff’, ‘precipitation’, ‘infiltration’, ‘basin’ and ‘recycle’, with high probability; and the ‘time series analysis’ topic may have words related to time series methods, such as ‘moving’, ‘average’, ‘seasonality’ and ‘trend’, with high probability. The topic distribution for each document and the term distribution for each topic are latent variables. The major task for structural topic modeling is to infer these latent variables with collected texts. After the inference, each article will have a topic distribution on the identified topics and the whole corpus also has an aggregate topic distribution by integrating the topic distributions of all individual articles.

The most frequent terms in a topic reflect the semantic meaning of the topic. However, the semantic meaning can be perceived and summarized only by manual qualitative inspection. Articles containing abundant frequent terms of a topic are assigned a high proportion of that topic and subsequently are identified as representative articles of that topic. Close reading of representative articles for each topic is a necessary step to label topics and evaluate the quality of a model. We selected the 50 news articles with the highest topic proportion of a topic as the representative articles of that topic for close reading in this study.

In order to determine the number of topics and to select a robust result, we ran multiple models with different numbers of topics and calculated some statistical measures, including exclusivity, semantic coherence, held-out likelihood and residual, of these models, using the ‘searchK’ and the ‘selectModel’ functions (Roberts *et al.*, 2014). Reliance on only statistical measures may lead to the selection of less-meaningful models (Levy & Franklin, 2014). Hence, we relied more on qualitative analysis, which was based on authors’ inspection of the most distinguishable terms and close reading of the most representative articles of each topic, to attain our preferred model shown in this paper. In fact, most applications using topic modeling rely on manual checking to determine the number of topics (Tvinnereim & Fløttum, 2015; Jiang *et al.*, 2016). Finally, a 30-topic model was selected as qualitative analysis showed that this model was the most-meaningful one in terms of semantic coherence within topics and exclusivity between topics. A 30-topic model also conformed to our anticipation of finding medium-grained topics in the corpus.

Each topic in the 30-topic model was manually given a specific label, based on the above-mentioned qualitative analysis, to describe its practical significance, and 28 of the 30 topics were further categorized into four perspectives, including economy, politics, environment, and technology. The remaining two topics seemed to have no specific theme and were classified as noise. A topic could be categorized into more than one perspective if the topic discussed issues across different perspectives, and the proportion of this topic was divided equally into the perspectives when calculating the proportions of different perspectives.

Topic divergences were generated on the basis of linear regression models with topic proportions for each of the 28 topics as dependent variables and origin country as the explanatory variable. We used T-statistics to perform significance testing. The T-statistics were based on standard errors that combine both estimation uncertainty from the topic induction process (Roberts *et al.*, 2014) and estimation uncertainty from the linear regression models.

## 5. Results

### 5.1. Publication trends

The collected 1,569 news articles were published in 290 newspapers from 34 countries or regions, dominated by India with 837 articles, followed by the United States (174), the United Kingdom (123), Pakistan (90), China (84), Bangladesh (59) and other countries (all fewer than 30). The time frame is from January 1979 to September 2015. Figure 1 presents the publication trends of ‘Brahmaputra hydropower’ related English news articles in China, India, the USA and the UK, and the entire world. Significant increases in recent years, particularly since 2010, are shown in the publication trends of India, the USA and the UK, and the entire world. The publication trend of China starts to increase from 2013. The decline in 2015 shown in all the four trends can be attributed to the uncompleted statistics in 2015.

### 5.2. Details of topics

The selected topic model reveals 30 topics, as shown in Table 1, from the news corpus. Terms shown in the second column of Table 1 are the five most-frequent terms plus five most-exclusive terms of each topic (Tvinnereim & Fløttum, 2015). Hyphens indicate stemming, for instance, the term ‘industri-’ comprises ‘industry’ and ‘industrial’. Labels and perspectives of each topic in Table 1 are suggested

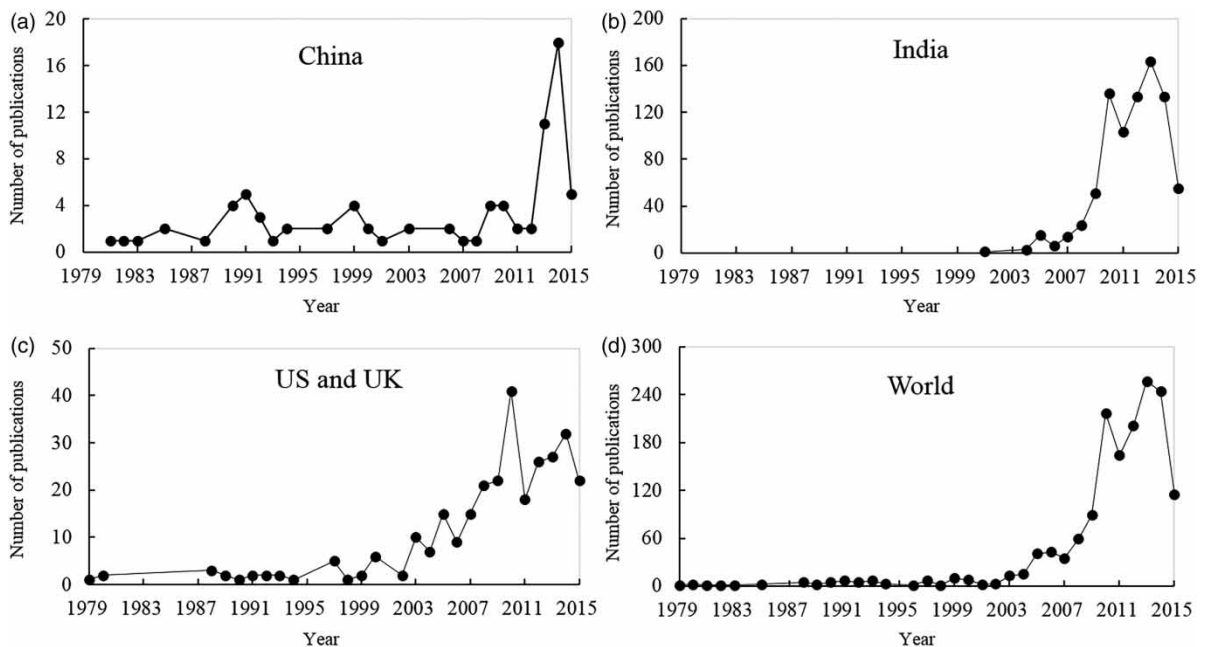


Fig. 1. Publication trends of ‘Brahmaputra hydropower’ related English news articles in (a) China, (b) India, (c) the USA and the UK, and (d) the entire world.

Table 1. Most discriminating words by induced topic, with suggested topic labels and perspectives.

No.	Most discriminating terms (frequency and exclusivity)	Label	Perspective	Proportion
1	China, India, river, Brahmaputra, dam, Tsangpo, Zangmu, Yarlung, divert, Krishna	Sino–Indian relations on the Brahmaputra	Politics/ Environment	13.7%
2	dam, project, Assam, said, Subansiri, KMSS, Akhil, AASU, Samiti	Dam-related campaigns in India (Assam)	Politics	7.4%
3	project, Arunach-, Pradesh, river, dam, Siang, Lohit, clearanc-, Dibang, Demw-	Domestic politics of India (Arunachal)	Politics	6.3%
4	Assam, contact, pleas-, com, Hindustantim, htsyndic, syndic, editor, permiss-, queri-	Domestic politics of India (Assam)	Politics	6.2%
5	Tibet, region, China, develop, provinc-, mln, Huaneng, Yuan, kilowatt, Sichuan, Lhasa	Provincial development plans in China	Politics/Economy	5.6%
6	water, river, will, flow, resourc-, flow, basin, Nile, divert, drought	Hydrological environment	Environment	5.6%
7	power, hydropow-, project, generat-, capac-, electr-, instal-, grid, potenti-, cost	Hydropower technology	Technology	5.3%
8	state, project, minist-, flood, said, NEWRA, Ganga, rejuven-, board, crore	India's water policy and plan	Politics/ Environment	5.2%
9	dam, river, Mekong, project, hydropow-, Salween, gorg-, Lao, Yangtze, fish	Development of the Mekong and the Salween	Politics/ Environment	4.7%
10	glacier, river, said, melt, chang-, Fraser, ice, glacial, snow, scientist	Glacier	Environment	4.0%
11	India, said, two, countri-, border, Wen, Jiabao, premier, Singh, Manmohan	Sino–Indian relations	Politics	4.0%
12	flood, peopl-, year, area, forest, tiger, rain, tree, habitat, speci-	Human–nature relationship	Environment	3.7%
13	one, will, even, now, can, rememb-, politician, happen, might, perhap-	Common words in news articles	Noise	3.2%
14	Bangladesh, India, river, water, Gang-, Farakka, NRLP, Dhaka, Hasina, Koshi	Bangladesh–India relations on the GBM	Politics/ Environment	2.7%
15	China, Chines-, Beij-, resourc-, intern-, Burma, Chellaney, disput-, win	Resource disputes with China	Politics	2.6%
16	Pakistan, India, treati-, Indus, south, Neelum, Kishenganga, arbitr-, Baglihar, Mahakali	Pakistan–India relations on Indus	Politics/ Environment	2.0%
17	countri-, cooper-, region, agreement, issu-, negoti-, rep-, parti-, democraci-, secretari-	Common terms in politics	Politics	1.9%
18	earthquak-, govern, Assam, India, peopl-, BJP, seismic, magnitud-, quak-, poll	Natural hazards and politics	Politics/ Environment	1.8%
19	India, region, Bangladesh, econom-, trade, SAARC, transit, cargo, GES, waterway	Bangladesh–India relations	Politics	1.8%
20	energi-, India, product, oil, coal, renew, product, fuel, solar, wind	Indian energy resources	Technology	1.7%
21	power, plant, compani-, project, construct-, tender, KEC, contract, award, deliveri-	Power plant project management	Technology	1.5%
22	climat-, food, chang-, environment, develop, Fulbright, car, emiss-, nexus, innov-	Climate change impacts	Environment	1.5%
23	develop, support, forc-, nation, secur-, USAID, PAPP, PLA, train, task	Development and national security	Politics	1.5%

(Continued.)



Table 1. (Continued.)

No.	Most discriminating terms (frequency and exclusivity)	Label	Perspective	Proportion
24	per, industri-, develop, cent, govern, school, farmer, herdsman, grain, incom-	Society and economy development	Politics/Economy	1.3%
25	China, secur-, state, Taiwan, risk, terror, Korean, terrorist, navi-, SCO	China's diplomacy (East Asia)	Politics	0.9%
26	Tibet, Tibetan, govern-, peopl-, Dalai, serfdom, Panchen, Lama, autonomi-, Buddhist	Tibetan society, religion and history	Politics	0.9%
27	power, region, nuclear, will, demand, pacif-, market, demand, thermal, UMPP	Energy sector analysis	Economy/ Technology	0.8%
28	generat-, BMI, forecast, India, estim-, OPEC, twh, bbl, PED, toe, BCM	Indian power sector	Economy	0.8%
29	know, think, just, thank, one, menzi-, inaud, realli-, unknown, rare	Common words in interview reports	Noise	0.7%
30	trend, river, year, figure-, climat-, Warsk, Mann, streamow, Kendal, signic-	Engineering hydrology	Environment/ Technology	0.6%

Abbreviations in Table 1 are explained in Appendix A (available with the online version of this paper).

based on qualitative analysis of the content of the discriminating terms and the representative articles. Topics in Table 1 are sorted according to their proportions in the whole corpus, from the highest to the lowest. The most-dominant topic has a proportion of 13.7%, while the rarest topic has a proportion of 0.6%.

The highest ten topics were labeled as ‘Sino–Indian relations on the Brahmaputra’, ‘Dam-related campaigns in India (Assam)’, ‘Domestic politics of India (Arunachal)’, ‘Domestic politics of India (Assam)’, ‘Provincial development plans in China’, ‘Hydrological environment’, ‘Hydropower technology’, ‘India’s water policy and plan’, ‘Development of the Mekong and the Salween’, and ‘Glacier’, with proportions ranging from 4.0% to 13.7% and totally accounting for 64%.

Politics is the most-frequent perspective in the news framing, with a proportion of 52.0%, followed by environment (30.2%), technology (9.2%), economy (4.6%) and noise (3.9%). Politics perspective comprises inter-state relations between stakeholder countries and domestic politics in riparian countries, mainly India and China. Environment perspective involves development of international rivers, such as the Brahmaputra, the Ganges, the Indus, the Mekong, the Salween, etc. In addition, some globally significant environmental issues, including natural hazards, climate change impacts and glacier status, are also identified as independent topics in the corpus. Technology and economy perspectives are less frequently discussed, and mainly focus on the energy sector.

### 5.3. Country divergences

Effects of origin country on topic prevalence are shown in Figure 2. Divergences, which are statistically significant at  $p < 0.01$  level, are presented. In Figure 2(a)–2(c), ‘Other countries’ means all countries excluding China, India or Bangladesh, respectively. In Figure 2(d), ‘Riparians’ means the collective of China, India and Bangladesh, and ‘Non-riparians’ means all countries excluding the riparians.

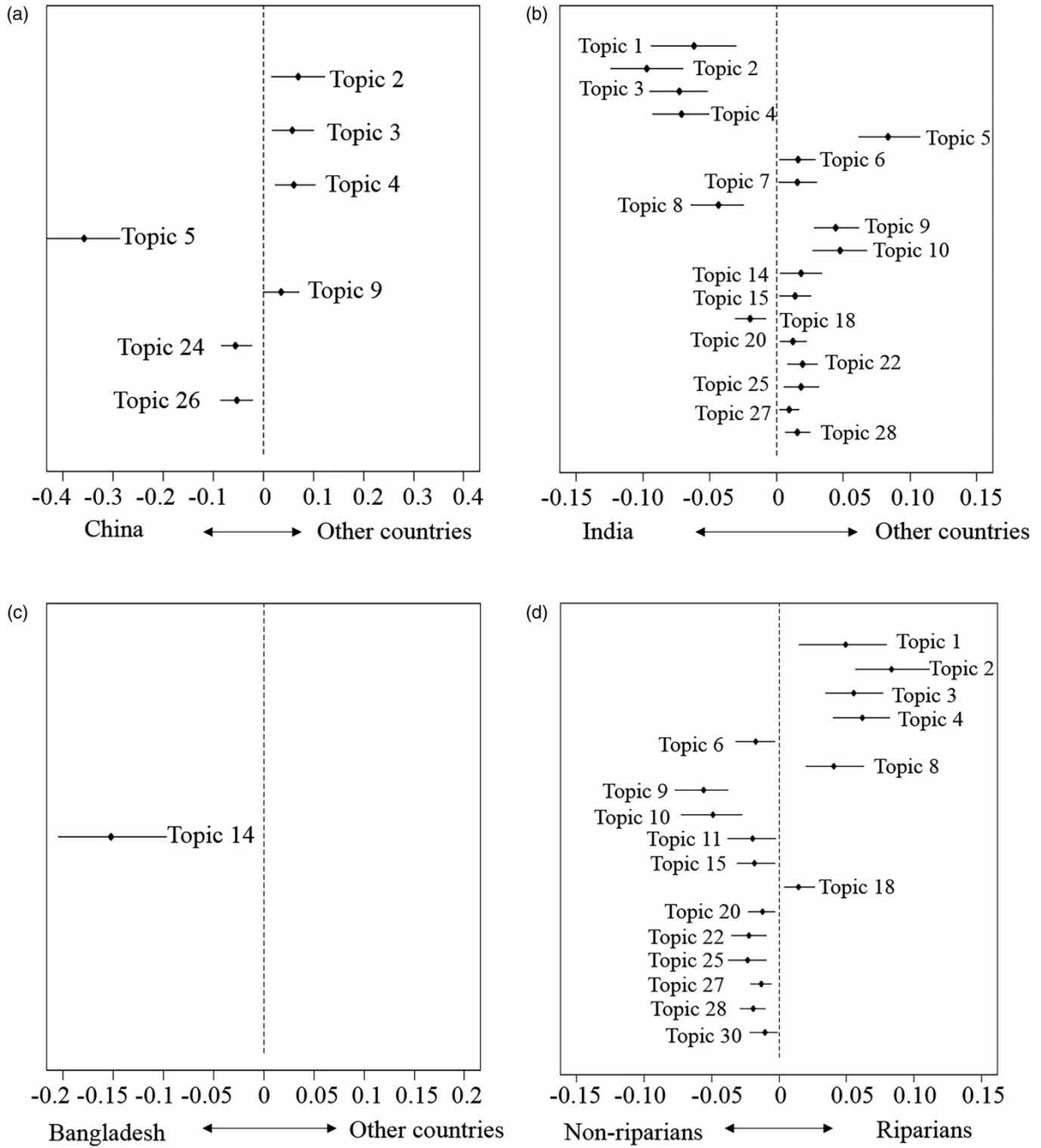


Fig. 2. Effect of country on topic prevalence. (a) Topic divergences between China and other countries, (b) topic divergences between India and other countries, (c) topic divergences between Bangladesh and other countries, and (d) topic divergences between non-riparian countries and the three riparian countries.

Topics on the left of the zero line are more likely to be reported by Chinese news (a), Indian news (b), Bangladeshi news (c) and non-riparian news (d).

As can be seen in Figure 2, the Chinese media put more emphasis on ‘Provincial development plans in China’ (Topic 5), ‘Society and economy development’ (Topic 24) and ‘Tibetan society, religion and history’ (Topic 26) than do other countries. The Indian media focus more on ‘Sino–Indian relations on the Brahmaputra’ (Topic 1), ‘Dam-related campaigns in India (Assam)’ (Topic 2), ‘Domestic politics of India (Arunachal)’ (Topic 3), ‘Domestic politics of India (Assam)’ (Topic 4), ‘India’s water policy and plan’ (Topic 8) and ‘Natural hazards and politics’ (Topic 18) than do other countries. The Bangladeshi media put more emphasis on ‘Bangladesh–India relations on the GBM’ (Topic 14) than do other countries.

The significant divergences between riparian countries and non-riparian countries are shown in Figure 2(d). Compared with non-riparian countries, riparian countries focus more on ‘Sino–Indian relations on the Brahmaputra’ (Topic 1), ‘Dam-related campaigns in India (Assam)’ (Topic 2), ‘Domestic politics of India (Arunachal)’ (Topic 3), ‘Domestic politics of India (Assam)’ (Topic 4), ‘India’s water policy and plan’ (Topic 8) and ‘Natural hazards and politics’ (Topic 18). Meanwhile, non-riparian countries focus more on ‘Hydrological environment’ (Topic 6), ‘Development of the Mekong and the Salween’ (Topic 9), ‘Glacier’ (Topic 10), ‘Sino–Indian relations’ (Topic 11), ‘Resource disputes with China’ (Topic 15), ‘Indian energy resources’ (Topic 20), ‘Climate change impacts’ (Topic 22), ‘China’s diplomacy (East Asia)’ (Topic 25), ‘Energy sector analysis’ (Topic 27), ‘Indian power sector’ (Topic 28) and ‘Engineering hydrology’ (Topic 30).

## 6. Discussion

The results presented in this paper are exploratory. We have identified the major topics of how the Brahmaputra hydropower development is framed in the English news media, based on a systematic analysis of a large and representative corpus. Major findings and implications of this study are discussed as follows.

### 6.1. Increasing concerns on the Brahmaputra

The dramatic increase in publications since 2010 can be attributed to the start of the Zangmu hydropower project, which is China’s first dam built on the mainstream of the Brahmaputra. The Indian media were greatly shocked by the news, as shown by the number of related news articles published in India, increasing from 51 in 2009 to 136 in 2010. Most of these articles were published after April 2010, when China officially announced that the dam was under construction. In addition, as can be seen from Table 1, the term ‘Zangmu’ has been identified as a discriminating term of the most-dominant topics in our topic model.

As a downstream country, India depends on China for collecting and delivering hydrological data and for leaving a regular discharge of the river. The Zangmu dam strengthens China’s ability of discharge control and makes India become more dependent on China for flow of what was free-flowing. Although China has assured India that ‘the hydroelectric project it was building on the Brahmaputra river in Tibet will not harm India’s interest’ (*Indian Express*, 2011), the Indian media still expressed their great

Table 2. Sample quotes discussing the Zangmu hydropower project.

Title	Sample text
Chinese disaster in the making	India, therefore, has to take immediate actions to engage China in serious discussions on the trans-boundary rivers ... We should not remain as mute spectators watching helplessly our neighbor's plans. We have to protect our interests ...
China admits to Brahmaputra project	After several years of denying the existence of any river project on the Brahmaputra, China has finally admitted to India that they are indeed building a hydropower project on the river ... While India will celebrate the improved trust quotient with China, in reality, it cannot make a huge hue and cry over these projects of an upper riparian state ...
Dam on Brahmaputra	The Chinese continue to deny that they are pursuing the much more ambitious 'Western Canal' project which will divert the waters of the Brahmaputra to feed arid portions of north-east China. Such denials, or even the assurance that dams on the Brahmaputra will make minimal impact downstream, will be cold comfort to a region like Assam, which is so heavily dependent on the river and its tributaries.

concerns about the dam. Table 2 presents some sample quotes, expressing concerns and worries regarding the Zangmu project, published by Indian news media in 2010.

International media have also paid more attention to the issues since 2010. This attention is reflected by the significant increase in the number of related news articles published in the USA or the UK. We attribute the increase to the same reason, the construction of the Zangmu project. From an international political perspective, disputes between China and India on the Zangmu project showed the rising Sino-Indian tension in geopolitical terms at that time. The Zangmu dam, and other dams under construction or in planning on the Brahmaputra River, was a potential trump card of China in Sino-Indian relations, when US-Indian relations gained momentum after the inauguration of Barack Obama in 2009 (Biba, 2014). Concerns of the US media are reflected in their news reports with divisive titles, such as 'Beneath the pomp, India and China are drifting apart' (Yardley, 2010a) and 'As India's global relations warm, gap with China is widening' (Yardley, 2010b). Discussion of the hydropower development on the Brahmaputra was continuously hot in Indian and international media from 2010 to 2014. China's announcement of the approval of three more hydropower dams on the Brahmaputra in January 2013 (The Hindu, 2013) also stimulated the discussion during the period.

However, China's media kept relatively quiet in the English public sphere before 2013. In 2010, the only published article (reprinted three times) was entitled 'China economic news in brief: Tibetan medicine giant, hydropower station' (Xinhua General News Service, 2010), where hydropower development on the Brahmaputra River was understated. In 2011, the only voice from China's media emphasized the dispute between India and Bangladesh on the Brahmaputra, with India being the upstream and dominant country (Xinhua General News Service, 2011). This news showed that China wanted to occupy a moral high ground in the similar dispute with India. In 2012, China's media just reported 'Tibet charting 44 rivers for water management' (Xinhua General News Service, 2012). This news can be read as a signal that China was preparing to comprehensively develop more water resources in Tibet. Since 2013, China's media have participated more frequently in the discussion on the Brahmaputra hydropower development issue, and confidently announced that the Zangmu hydropower project was completed and went into operation in 2014. Due to political reasons, China's English news agencies, including Xinhua News Agency, *China Daily* and *Shanghai Daily*, are controlled by the Chinese government and are often regarded as a guide to Chinese government policies (Curtin, 2012). Therefore, these

framing clues may mirror that China has gradually shown its initiatives and advantages in development of the Brahmaputra.

## 6.2. Political perspective in riparian media framing

According to the topic modeling result, the Brahmaputra hydropower development issue in the mass media was framed to refer rather to politics than to the water resource or energy sectors. This is in accordance with previous studies, which have also shown a link between the debate on resource issues and political problems (Teräväinen *et al.*, 2011; Świątkiewicz-Mośny & Wagner, 2012).

China and India, which are the two major actors in this geopolitical game, have been identified by the topic model as the two most-discriminating terms of the most-dominant topic. Previous studies have found that intra-national political challenges in and international political tensions between China and India create great obstacles to cooperative agreements in sharing the Brahmaputra water resources (Ray *et al.*, 2015). The topic model has also revealed these political challenges explicitly. For instance, Topics 2, 3 and 4 emphasize the domestic political problems, including ethnic fragmentation and unrest, in north-east India; Topics 5 and 26 present China's concerns about the Tibet Autonomous Region; and Topics 1 and 11 identify the Sino-Indian relations not only on the river-sharing issues but also on the territorial disputes between them. These specific topics have also been identified as key factors governing the regional politics in previous studies using qualitative analysis (Shimray, 2004; Barnett, 2009; Malone & Mukherjee, 2010).

In addition to the Brahmaputra, China and India, respectively, have other transboundary river problems, which are also reflected in the topic model. Topic 9 addresses the development of the Mekong and the Salween, which caused disputes between China and Indochina countries (Grumbine *et al.*, 2012); Topic 14 addresses the Bangladesh-India relations on the GBM river system (Brichieri-Colombi & Bradnock, 2003); and Topic 16 addresses the Pakistan-India relations on the Indus (Zawahri, 2009). These topics show that the media often discuss these transboundary river issues together with the Brahmaputra, providing samples for reference in policy making and treaty signing.

National interests, which are represented by country divergences on different topics, are also important implications in this study. China is central to regional water games in vast parts of Southeast, South, Central and Northeast Asia, because several large international rivers, such as the Indus, Mekong, Salween, Eerqisi and Brahmaputra, originate in China. Hence, China has advantages over its neighbors in development of these transboundary rivers and has already launched unilateral projects to make use of these rivers. Meanwhile, the Chinese government needs a tranquil periphery to maintain its societal stability and economic growth (Biba, 2014). Therefore, the Chinese government has tried to avoid escalating any potential conflict in transboundary river issues. This attitude is reflected by the topic divergences between China and other countries. The three topics that China's media emphasize are all related to domestic development. In addition, as shown in Figure 2(a), China obviously avoids discussing the development of the Mekong and the Salween (Topic 9). India's media have a similar performance. Besides its domestic political issues (Topics 2, 3, 4, 8 and 18), as the vulnerable party in the Brahmaputra issue with China, India's media put more emphasis on Topic 1, which addresses the issue. However, as the dominant party in the GBM issue with Bangladesh, India obviously avoids discussing Bangladesh-India relations on the GBM (Topic 14), which is emphasized by Bangladesh's media. These findings show that advantages of upstream states and dependences of downstream states can be mirrored by their news framing.

### 6.3. Other perspectives in international media framing

The topic divergences between non-riparian countries and riparian countries can reflect international media interests on the Brahmaputra hydropower development issue. The international media address the issue in different perspectives from the three riparian countries.

First, the international media focus more on environmental problems, including ‘Hydrological environment’ (Topic 6), ‘Glacier’ (Topic 10), ‘Climate change impacts’ (Topic 22) and ‘Engineering hydrology’ (Topic 30). This is in accordance with [Sadath et al. \(2013\)](#), which finds that with regard to an issue of conflict involving both environmental and social aspects, the international media focus more on environmental concerns, meanwhile, national media focus more on political or social concerns. With regard to the Brahmaputra hydropower development issue, the global environmental concerns, such as glacier status and climate change impacts, better fit the scope of international media.

Second, international media focus more on resource problems, including ‘Resource disputes with China’ (Topic 15), ‘India energy resources’ (Topic 20), ‘Energy sector analysis’ (Topic 27) and ‘India energy sector’ (28). Resources, particularly energy resources, are of global concern ([Ferguson, 1994](#)). India has been the world’s third-largest energy consumer and accounts for 34.7% of the global consumption increment in 2014 ([Live Mint, 2015](#)). The Brahmaputra basin possesses 44% of India’s total hydropower potential, which is important for the Indian government to ensure electricity supply and to reduce carbon emissions. Hence, in news reporting of the international media, the Brahmaputra hydropower development issue is frequently linked to energy strategies of the riparian countries, especially of India.

Finally, the international media also focus on politics. However, compared with the media of riparian countries, the international media pay more attention to broader political issues related to the Brahmaputra. For instance, Topic 9 focuses on the development issues on the Mekong and the Salween, which are similar cases to the Brahmaputra development. Although China’s media avoid discussing this topic, the international media like to combine these transboundary river cases into an overall analysis framework. Topics 11 and 25 also address more-general diplomatic issues, including Sino–Indian relations and China’s diplomacy (East Asia). Considering the media’s function of mediating public debate, the topic divergences between the riparian and international levels may indicate incongruent public information and opinion about the issue under consideration ([Sadath et al., 2013](#)).

### 6.4. Limitations and future work

The results of this study should be qualified by the following limitations. First, this study uses only English news articles. Hence, non-English, especially Chinese, news data are not included. Although we have identified the information that China’s media and the Chinese government want to convey to the world, how the Brahmaputra hydropower development issue is framed in the Chinese public sphere is still unknown. Second, the number of news articles is unevenly distributed across countries, and most articles are published in India, meaning that topics related to India account for a high proportion in the whole corpus. However, according to our original intention and data search strategy, the corpus we collected is actually an integration of discussion of the Brahmaputra hydropower development issue in the whole English public sphere. The preponderance of Indian media is a fact. In addition, most implications of this study are derived from topic divergence analysis, which is not influenced by the uneven distribution of articles in different countries. Finally, the STM requires manual judgment and interpretation. Although we have tried to eliminate the bias, subjectivity is inevitable.

Further studies will include multi-language (Chinese, Hindi, Bengali, etc.) data sources to provide a more-comprehensive description of how the transboundary river issue is framed in the domestic public spheres of China, India and Bangladesh. Individual comments in social media, such as Facebook, Twitter and Weibo (Chinese Twitter), will be combined with traditional media data to investigate the influence of traditional media on people's perception of transboundary river disputes. Other data-mining approaches, such as sentiment analysis and social network analysis, will be implemented to provide more perspectives for understanding the transboundary river issue.

## **7. Conclusion**

This paper explores how the Brahmaputra hydropower development issue is framed in English news media of different countries. A computer-assisted text-mining approach, structural topic modeling, is used to establish a 30-topic model to reveal the intellectual structure of the news corpus. Topic divergences are identified to present national and international interests on this transboundary river issue. Major findings of this study are summarized as follows:

- (1) The Brahmaputra hydropower development issue is increasingly attracting the attention of news media worldwide. The construction of the Zangmu project has stimulated the discussion on the issue since 2010.
- (2) Political perspective dominates the framing of the Brahmaputra hydropower development issue in English news media, particularly in news media of the three riparian countries, i.e. China, India and Bangladesh.
- (3) Significant framing divergences among riparian countries show that advantages and dependences on sharing an international river can be reflected in news reporting.
- (4) The international (non-riparian) media focus more on environment, resource and energy problems, which better fit the scope of international media.

In fact, all three riparian countries, i.e. China, India and Bangladesh, plan to develop the huge hydropower potential on the Brahmaputra River. However, the lack of mutual understanding creates obstacles against a harmonized cooperation on the development. This study is a response to the lack of mutual understanding, by modeling all related English news articles into a topical figure and finding topical divergences among different countries. These results can promote mutual understanding among riparian countries on the Brahmaputra development issue. Since China has been implementing several hydropower projects on the mainstream of the Brahmaputra, continuous monitoring of related news reports is necessary for the three riparian countries to achieve a win-win situation. The analysis approach proposed in this study is expected to be widely used as a methodological strategy in future studies on international river issues.

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