News Media Coverage of Conflict and Cooperation Dynamics of Water Events in the Lancang-Mekong River Basin

Jing Wei[1], Yongping Wei[2], Fuqiang Tian[1*], Natalie Nott[2], Claire de Witt[2], Liying Guo[1], You Lu[1]

[1]Department of Hydraulic Engineering, State Key Laboratory of Hydroscience and Engineering, Tsinghua University, Beijing 100084, China

[2] School of Earth and Environmental Sciences, University of Queensland, St. Lucia, QLD 4072, Australia

Correspondence to:

Fuqiang Tian, tianfq@mail.tsinghua.edu.cn

Submitted to *Hydrology and Earth System Sciences*

Special issue: Socio-hydrology and Transboundary Rivers

Deleted: An Analysis

Deleted: over

Abstract

Riparian countries have their respective values and priorities for water management, and their values of shared water often has possible impacts for their propensity to involve in cooperative management and adhere to treaties/agreements. Improving transboundary water management therefore firstly requires nuance understanding of the changing values and interests of each riparian country to better understand factors that encourage and discourage changes toward cooperation or conflict. This paper provides understanding of the evolution of conflict and cooperation dynamics in Lancang-Mekong River Basin with in-depth analysis of the perspectives of multiple countries. Newspaper articles were used as a key data source as it provides insights into events reported on by the media that are representative of each country/sector they are published within. The results depict a continual trend of cooperative sentiments towards water events occurring within the region. The six riparian countries (China, Myanmar, Laos, Thailand, Cambodia, Vietnam) have had a greater average sentiment score for cooperation than international countries for the majority of the study period showing that the region perceived transboundary water management more positively than global audiences. Except for few outliers, the trend also shows that countries further downstream showed lower cooperative sentiments. Dam infrastructure was often negatively reported, thus, it is likely a major contributor to conflict for the Lancang-Mekong River Basin, while events that are positively reported are those that aid in connecting leaders and project developers between riparian countries including meetings, bilateral and multilateral cooperation and development projects. These findings provide the basis for further revealing the mechanism of cooperation and conflicts through understanding these inherent and diverse perspectives of each riparian country, we can gain an insight into the underlying interests that create conflictive or cooperative environments and ultimately predict and manage cooperation/conflict in transboundary rivers.

Keywords: transboundary river management, conflict and cooperation, Lancang-Mekong river basin, newspaper, sentiment analysis, societal value, big data

Deleted: states

1. Introduction

Globally there are 310 transboundary rivers that flow across more than 47% of the world's land surface (McCracken and Wolf, 2019), providing approximately 60% of the global river flow (Wolf et al., 2005). Transboundary river flows across political boundaries with spatial and temporal variance, often resulting in conflicting criteria for its uses among riparian nations. The very different views on how the water should be used, and how it should be managed makes collaborative management difficult (Sunchindah, 2013). Tensions and uncertainties often occur when sharing this consumable, indispensable resource and compounded by the dynamic interaction of hydrological, technical and social systems (Zeitoun and Mirumachi, 2008). Transboundary rivers are therefore characterized for evolving cooperation and conflict dynamics (Wolf et al., 1999;Petersen‐Perlman and Wolf, 2015;Yoffe et al., 2003;Zeitoun and Mirumachi, 2008).

Understanding transboundary waters by conflict and cooperation has been a dominant approach embraced by many scholars in different disciplines (Wolf et al., 2003;Yoffe et al., 2003;De Stefano et al., 2010;Zawahri, 2008;Gleick, 1998). As the first and fundamental advance to analyse the tendency for conflict or cooperation along international rivers, few inventories have been built up to provide global snapshot of conflict and cooperation dynamic to recognise future tensions. Often cited is the Transboundary Freshwater Dispute Database (TFDD) developed by Oregon State University (Wolf, 1999) that compiled historical water incidents, both conflictive and cooperative, on a global scale from 1948 to 2008. Based on the data, Basin in Risk Projects (BAR) (Yoffe and Larson 2001) categorised intensities of water incidents, varying between-7 and +7, in order to understand possible social - political threats. Underpinned by the recognition that cooperation and conflict are not a binary construct, as all-or-nothing (Grey and Sadoff, 2002), but rather in co-existence, In their Transboundary Waters Interaction Nexus (TWINS) tool, Zeitoun and Mirumachi (2008) attended to the nexus of water conflict and cooperation underlining the dual nature of interaction.

Deleted: world's freshwater

Formatted: (Asian) Chinese (China), (Other) English (US)

Moved down [2]: Given the future projections of population growth and aridity, some scholars even proposed the idea of global 'water wars' (Cooley, 1984;Starr, 1991;Bulloch, 1995;Remans, 1995;Gleick, 1993), emphasizing that management of international rivers will be a challenging task if knowledge of conflict and cooperation is not fully developed (Song and Whittington, 2004;Barnaby, 2009). ¶

Formatted: Font color: Dark Red

Formatted: New paragraph, Pattern: Clear

Formatted: Font color: Dark Red

Formatted: Font color: Dark Red

Moved (insertion) [1]

Deleted:

However, current event-based approach is inadequate to recognise the nuance nature of conflict and cooperation instances, i.e. lack of understanding of each riparian country's attitude/value toward the shared river. Simply classifying water events into conflict or cooperation could mask various forms of conflictive or cooperative responses elicited from each riparian country underneath (Watson et al., 2009). Riparian countries have their respective values and priorities for water management (Wolf et al., 2005;Di Baldassarre et al., 2013), and their attitudes toward shared water often has possible impacts for their propensity to involve in cooperative management and adhere to treaties/agreements. Understanding value in the context of transboundary river basins is therefore vital for developing effective management and policies toward cooperation (Bennett and Dearden, 2014;Hartley, 2006;Larson et al., 2009;Turner et al., 2014).

Values, arising from the concept of culture along with norms and beliefs, posit as deeply held ideas that influence on water management decisions and outcomes (Caldas et al., 2015;Roobavannan et al., 2018;Wei et al., 2017). Shaping the way we see, perceive and interpret the outer environment (Caldas et al., 2015), values is considered as mediating variable that connect human with the natural environment. In the context of transboundary rivers, where multiple water users are interconnected (Petersen-Perlman et al., 2017), their different values towards their shared water are often manifested as conflictive or cooperative attitudes toward other competing water users, when further complicated by the interdependent web of hydrological, political, economic, technical, and social processes (Dinar, 2004;Di Baldassarre et al., 2019), could resulted in greater cooperation or conflict at basin-scale. Improving transboundary water management therefore firstly requires nuance understanding the changing values and interests of each riparian country, however, it remains under researched. An in-depth analysis that looks into each riparian country's conflictive or cooperative perspectives is key to understand their cooperative or non-cooperative behaviour. Therefore, this paper aims to provide a new perspective to understand the conflict and cooperation dynamics by highlighting each country's conflictive or cooperative attitude towards their shared water. Lancang-Mekong River Basin is taken as a case study to investigate how has the conflict and cooperation dynamics as

Formatted: Font color: Dark Red

reflected by each riparian country changed over time and main issues associated with the conflictive and cooperative sentiments.

Recently, conflict and cooperative dynamics in transboundary rivers have also been considered as a socio-hydrological phenomenon (Di Baldassarre et al., 2019), emerged as a result of the long-term evolution of hydrological, political, economic, technical and social processes settled within the transboundary system (Di Baldassarre et al., 2019). Socio-hydrological approach, which emphasize the feedback mechanism between human and water system, is thus proposed in understanding transboundary river problem to unravel how and why different actors came into cooperation. Value, as the key social element, has been found as key driver that guide water use behavior or management focus from human uses to restore ecological flows (Roobavannan et al., 2018;Wei et al., 2017) in the context of local-scales socio-hydrological models and studies, i.e. urban or agricultural sectors in river basin (Elshafei et al., 2014;van Emmerik et al., 2014;Li et al., 2013;Chen et al., 2016;Kandasamy et al., 2014). In the context of transboundary river, challenges exist in how to measure value and make it possible to more rigorously model value in transboundary socio-hydrological models. Therefore the potential implication of this paper is to serve as a reference to measure this social element at transboundary level in socio-hydrological models or similar studies, and ultimately contribute to understanding the mechanism that drives the conflict or cooperation choices in the long run. Meanwhile, by identifying the conflictive/cooperative sentiments exhibited by each country and the main issues associated with cooperative/conflictive sentiment, it can serve as a reference for water managers to collaboratively identify, manage and overcome potential conflict to achieve effective transboundary water management.

2. Methods

Newspaper articles provide insights into events reported on by the media that are representative of each country/sector they are published within (Cooper, 2005). Through its noted "agenda-setting" capability, newspaper reflect what is important to the public as well as it shapes the public perception of an issue (Bengston et al., 1999;Hurlimann and Dolnicar, 2012;Neuendorf, 2017).

Formatted: Font color: Auto, English (UK)

Formatted: Font color: Auto, English (UK)

Formatted: Font color: Auto, English (UK)

Formatted: Font color: Auto, English (UK)

Formatted: Font: 11 pt

Formatted: Font: 11 pt

Formatted: Font: 11 pt, Not Highlight

Formatted: Font color: Auto, English (UK)

Deleted: ¶
A large and growing body of literature has attempted to explore factors that are potentially conductive to conflict, considering issues such as water scarcity (Dinar, 2009), climate change (Gleditsch, 2012;Nordås and Gleditsch, 2007;Raleigh and Kniveton, 2012), water quality (Wolf et al., 2005), and the role of transboundary treaties/river basin organizations (Song and Whittington, 2004;Dinar et al., 2019;Berardo and Gerlak, 2012;Zawahri and Mitchell, 2011); while others have explored cooperation management, focusing on scenario-based analysis of the distribution of benefits from cooperation, and benefit-sharing mechanisms as pivotal role in motivating cooperation (Hogarth and Dinar, 2015;Madani, 2010). Recently, conflict and cooperative dynamics in transboundary rivers have been considered as a socio-hydrological phenomenon (Di Baldassarre et al., 2019), emerged as a result of the long-term evolution of hydrological, political, economic, technical and social processes settled within the transboundary system (Di Baldassarre et al., 2019). Socio-hydrological approach is thus proposed in understanding transboundary river problem to unravel how and why different actors came into cooperation. ¶
As the first and fundamental advance to analyse the tendency for conflict or cooperation along international rivers, few inventories have been built up to provide global snapshot of conflict and cooperation dynamic to recognise future tensions. Often cited is the Transboundary Freshwater Dispute Database (TFDD) developed by Oregon State University (Wolf, 1999) that compiled historical water incidents, both conflictive and cooperative, on a global scale from 1948. Based on the data, Basin in Risk Projects (BAR) (Yoffe and Larson 2001) categorised intensities of water incidents, varying between-7 and +7, in order to understand possible social - political threats. Underpinned by the recognition that cooperation and conflict are not a binary construct, as all-or-nothing (Grey and Sadoff, 2002), but rather in co-existence, In their Transboundary Waters ... [1]

Formatted ... [2]

Moved down [3]: A large and growing body of literature explore factors that are potentially conductive to conflict, considering issues such as water scarcity (Dinar, 2009),

Moved up [1]: As the first and fundamental advance to for conflict or cooperation along international rivers, few inventories have been built up to provide global snapshot of

Moved (insertion) [2]

Moved (insertion) [3]

Moved down [4]: Case Study Area - Lancang-Mekong River Basin¶

Deleted: ¶

Newspaper has increasingly been recognized as a valid proxy to track societal values or public opinion (Wei et al., 2015;Wei et al., 2017;Quesnel and Ajami, 2017). Thus, utilizing newspaper articles as a key data source allows the analysis of the perceptions of different countries pertaining to water events over time.

This paper takes newspapers as data sources to uncover the conflictive and cooperative sentiments and associated topics in news coverage through sentiment analysis and topic analysis. The step-by-step illustration of how the data is collected and analysed is given in Figure 1. First of all, newspaper articles were collected from a database using pre-defined keywords, which resulted in total of 12,314 articles. All of these articles were then manually read by authors to remove irrelevant and duplicates articles based on pre-determined criteria, which left 3877 articles for final analysis. These articles were classified based on their origin of publication, and the conflictive and cooperative sentiments expressed from these articles were then determined using sentiment analysis, and the main topics associated with conflict/cooperation were analysed using topic analysis. More detailed step-by-step information were illustrated in each section below.

2.1 Data Retrieval

The Lexis-Nexis database was selected to extract newspaper information, which is home to more than 6000 news publications around the world and is among most commonly used news sources in the field of social sciences (Weaver and Bimber, 2008;Racine et al., 2010). Searching scope include both major English regional and international newspapers. Although English is not frequently used in most riparian countries, English newspapers are accessible and regularly reach an international audience, and is therefore considered a reference to the government's foreign policy (Curtin, 2012). News articles in these newspapers reflect national interests and political responses that riparian countries want to deliver to the international public.

The search terms are one of the key determinants of the validity and relevance of the data to be collected. The search terms used in this study, as seen in Table 1, were adopted from Yoffe and Larson (2001) and refined to enable the results to water events along the Lancang-Mekong river related to conflict and cooperation between riparian countries. Specifically, the five block of terms

Formatted: English (UK)

Deleted: It has been an important though challenging task to directly measure values related to environmental concern or specific evaluation towards certain issues (Roobavannan et al., 2018).

Deleted: News media has increasingly been recognized as a valid proxy to track societal values or public opinion (Wei et al., 2015;Wei et al., 2017;Quesnel and Ajami, 2017). News media write the first draft of history (Howland et al., 2006), it provide insights into events reported on by the media that are representative of each country/sector they are published within (Cooper, 2005). Through its noted "agenda-setting" capability, news media reflect what is important to the public as well as it shapes the public perception of an issue (Bengston et al., 1999;Hurlimann and Dolnicar, 2012;Neuendorf, 2017). The prominence of an issue reported in news media can be framed through frequency of coverage, content details, and prominent position, i.e. front page (Roznowski, 2003). Recently years have witnessed an increasing trend of examining the water-related news coverage to understand portrayal of water issues (Altaweel and Bone, 2012;Wei et al., 2015;Xiong et al., 2016), drought salience (Ruiz Sinoga and León Gross, 2013), public perception (Hale, 2010), societal values (Wei et al., 2017), or to link the volume of water-related news coverage with consumption behaviour change (Quesnel and Ajami, 2017) and public preferences in mitigation strategies (Russell-Verma et al., 2016). Thus, utilizing newspaper articles as a key data source for this project allows the analysis of the perceptions of different countries pertaining to water events in the Lancang-Mekong River over time. The approach for achieving the objectives of this paper is given in Figure 2.¶

Deleted: 3

Deleted: states

requires articles to be included in the search results must discuss “Mekong” river basin in one of topics indicated below, such as dam, irrigation, pollution, etc. These articles need to discuss the conflictive or cooperative aspects of the events involving at least one of riparian countries. The above categories can narrow down the search to the desired scope, with the list of unwanted words further screen out irrelevant topics.

2.2 Data Cleaning

Deleted: 3

Initially, the search generated a total of 12,316 results. To further ensure the accuracy of results, all articles were then manually read and examined for their relevancy to ensure the sentiment analysis to be conducted would be reflective of the perspectives of water events along the Lancang-Mekong. Those articles not relevant were removed from the analysis alongside any duplicate articles and those with missing necessary information including article body and date published. The relevancy of each article was determined using the criteria in Table 2. The final number of articles utilized for the analysis was 3,877 after all duplicates and irrelevant articles were removed.

2.3 Sentiment analysis and Topic Analysis

Deleted: 3

Generally, there are two ways of coding available when examining the news content, manual coding and computer-assisted coding. While manual coding could uncover latent content to a larger extent (Wei et al., 2015;Wei et al., 2017), it is more time consuming and less efficient when examining large datasets. Sentiment analysis, a widely used computer-based analysis, was utilized in determining the cooperative or conflictive perspectives towards water events, and how they have changed over time. Sentiment analysis is the process in which thoughts, attitudes and perceptions expressed in a text are identified and classified in computational way, particular in order to determine authors’ viewpoints and position towards certain issues (positive, negative, or neutral) (Danneman and Heimann, 2014). The sentiment analysis was conducted through the interface of R, a statistical software program. The process involved inputting textual data into the program, tokenising the sentences to differentiate each word from one another, and then attaching

the tokenised text to a sentiment lexicon to identify the overall sentiment (Danneman and Heimann, 2014). As there is no "conflict and cooperation" lexicon for transboundary rivers available, a general sentiment lexicon AFINN was utilized in this analysis. AFINN contains a total of 2,477 attached word-sentiments, which produces a positive and negative value on a scale from -5 to +5 (Nielsen, 2011). In order to represent the conflictive and cooperative sentiments, the searching scope has limited the articles content to instance of cooperation or conflict that occurs within an international basin involving one or more riparian to that basin. Therefore, the calculated sentiment scores based on AFINN scores ranging from - 5 to + 5 was considered being able to reflect the intensity of conflict and cooperation accordingly.

To reflect topics associated with conflict or cooperation in water events, topic analysis - Structural Topic Modelling (STM) (Roberts et al., 2014) was utilized. Structural Topic Modelling (STM) allows frequent words to be extracted from text, identify commonalities between the words, phrases and groups of words to generate a topical prevalence and topic content factor (Roberts et al., 2013). This tool is particularly useful when managing big data sources as the process to identify key topics manually is inefficient and time-consuming, whereas STM has the ability to identify topics automatically. The STM was processed by using the STM package in R (Roberts et al., 2014). The number of topics selected was ten which was decided through an analysis of the topics produced until clear, relevant topics emerged as a result. For example, at a chosen five topics, all topics were pertaining to water, resources, and the six riparian countries; however, at ten topics, there were more clear events emerging such as dam infrastructure, agriculture and fisheries. The topics were then manually labelled based on the most frequent words found within each topic as the statistical software cannot extrapolate the overall topic from most frequent words. This topic classification was based on previous literature reviews and the main water-related topics outlined in Wei et. al.'s (2015) study.

3. Case Study Area - Lancang-Mekong River Basin

Moved (insertion) [4]

The Lancang-Mekong River is one of the largest and longest river systems in South-East Asia. It flows from Tibetan plateau in China, down 4,880km through Myanmar/Burma, Lao PDR (Laos),

Deleted: , originates from the north-eastern rims of the

Thailand, Cambodia and exiting into the South China Sea through Vietnam (MRC, 2019b), as seen in Figure 2. The river courses that runs within China is named Lancang River, whilst river course flows through downstream is referred as Mekong River. The Lancang-Mekong River is an essential water source that supports the livelihoods for some 65 million people from the six riparian countries in maintaining food security and nutrition (Dugan et al., 2010).

The Lancang-Mekong River has experienced a lengthy record of conflictive and cooperative events, see Figure 3. Significant movement towards cooperation over water resources between the riparian countries primarily began in the 1950's when the Mekong Committee was established, consisting of the lower Mekong countries, after the Geneva Convention granted independence to Laos, Cambodia, and Vietnam (Hirsch and Cheong, 1996). This committee ran from 1957 to 1978 despite disagreements among the riparian countries in how the decision-making processes were implemented (Yorth, 2014). In 1995, all members of the Mekong River Commission (hereafter, MRC) signed the "Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin" (Hirsch and Cheong, 1996), with China and Myanmar presenting as Dialogue Partners of the MRC throughout discussions (Yorth, 2014). The beginning of the 21st Century has marked China's cooperative commitment for providing 24-hour water level and 12-hour rainfall data as well as entering cooperative regimes with the MRC (Dore, 2003). Meanwhile, construction of large-scale dams in upstream has received mounting criticism, i.e. the Xayaburi Dam, as the first of the eleven proposed cascade dams on the Lower Mekong began construction in 2010 despite a lack of agreement between all four lower Mekong countries and failure of the regional consultation process. After that, several treaties and plans were signed, including the Lancang-Mekong Environmental Cooperation Centre in 2016 and the formation of the Lower Mekong Committee (LMC) framework, marking a significant step towards cooperation.

One of the most prominent reason behind the tension between the riparian countries is their competing desires for the use of the water. China in particular has an interest in hydropower projects to generate electricity and also in clearing and expanding waterways to improve navigation for greater trade (Yorth, 2014). Myanmar has access to part of the Lancang-Mekong

Deleted: 1

Formatted: New paragraph

Deleted: nt sources of

Deleted: states

River through the sharing of a border with Laos but has not projected a preferred use of the water vocally but is generally cooperative with China (Yorth, 2014). Laos, similarly to China also has a great interest in hydropower developments and are in a position favourite to alter the downstream flow of the Mekong River (Dugan et al., 2010). Thailand primarily utilises water for agriculture and irrigation and diverts water from the main Lancang-Mekong tributary into its North-eastern areas for cultivation and exports (Nesbitt, 2005). Cambodia has a particular interest in preserving water quantity and quality for their fisheries sector to ensure aquatic species abundance (Yorth, 2014). As a result, Cambodia demands that fewer large structures are constructed along the Lancang-Mekong, such as dams and irrigation systems that may affect the sediment flow and water quantity downstream (Yorth, 2014). Vietnam has an interest in utilizing the water for agriculture and aquaculture and generally contests upstream dams that will have an effect on its water quantity for irrigation and aquaculture and its flood control abilities (Nesbitt, 2005).

4. Results

4.1 Overall News Coverage of Conflict/Cooperation Water Events on Lancang-Mekong River Basin

Overall, conflict and cooperation as reflected in newspaper coverage showed that there was an observed increase in both the number of conflictive and cooperative articles published over time. When examining the relative prominence of conflictive sentiments to cooperative sentiment over time as seen in Figure 4, there has consistently been a greater number of articles with cooperative sentiment than conflictive sentiments since 2002. This ratio of cooperative to conflictive articles published has remained relatively stable since 2000 with majority of all years having 60% to 70% of all articles being cooperative. There are also multiple peaks and troughs in terms of the proportion of cooperative and conflictive reported articles shown in Figure 4, peaks were reached in year 2004 and 2015, troughs were found in year 2011.

Deleted: ¶
The Lancang-Mekong River has experienced a lengthy record of conflictive and cooperative events. Significant movement towards cooperation over water resources between the riparian countries primarily began in the 1950's when the Mekong Committee was established, consisting of the lower Mekong countries, after the Geneva Convention granted independence to Laos, Cambodia, and Vietnam (Hirsch and Cheong, 1996). This committee ran from 1957 to 1978 despite disagreements among the riparian countries in how the decision-making processes were implemented (Yorth, 2014). In 1995, all members of the Mekong River Commission (hereafter, MRC) signed the "Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin" (Hirsch and Cheong, 1996), with China and Myanmar presenting as Dialogue Partners of the MRC throughout discussions (Yorth, 2014). The beginning of the 21st Century has marked China's cooperative commitment for providing 24-hour water level and 12-hour rainfall data as well as entering cooperative regimes with the MRC (Dore, 2003). Meanwhile, construction of large-scale dams in upstream has received mounting criticism, i.e. the Xayaburi Dam, as the first of the eleven proposed cascade dams on the Lower Mekong began construction in 2010 despite a lack of agreement between all four lower Mekong countries and failure of the regional consultation process. After that, several treaties and plans were signed, including the Lancang-Mekong Environmental Cooperation Centre in 2016 and the formation of the Lower Mekong Committee (LMC) framework, marking a significant step towards cooperation. ¶

Deleted: Overall, news articles pertaining to water conflict/cooperation events along the Lancang-Mekong River have increased in frequency since 1991. As seen in Figure 3a, Thailand, China and the international countries consistently have the largest number of articles published each year on this topic. There are also several peaks in year 2011, 2012, 2014 and 2016 where the number of articles published were considerably higher than years prior and following. ¶

Formatted: Font: 11 pt

Formatted: Paragraph

Deleted: (see Figure 3b)

Deleted: From 2014 to 2018, the number of articles with a cooperative sentiment was more than double that of the number of articles with a conflictive sentiment each year. Number of cooperative articles had peaked in 2016 and 2018, while definitive peak in the number of articles published with a conflictive sentiment was in 2011.

Deleted: b

Deleted: b

4.2 Topics associated with Conflict/Cooperation Sentiments

To understand the most concerned topics associated with conflict/cooperation sentiments, topic analysis was conducted with ten topics identified. It was found that nearly one third of all articles were pertaining to dam infrastructure, implying that this is a significant topic that countries have a vested interest in (Figure 5a). Following this there is a large proportion of topics that are associated with the reporting of relationships between countries or their cooperation. 30.4% of the overall topic proportion includes bilateral relations, multilateral relations, joint management and meetings. Thus, a significant proportion of all articles published have country interactions and relationships as a major topic.

Figure 5b also depicts the proportion of topics that are frequently associated with conflictive sentiment. Dam infrastructure and hydropower, which operate hand-in-hand, were negatively reported by the media accounting for 60% of the total topics. Whilst another 10% of all negative articles had a focus on meetings, bilateral relations, flooding and fishing/environment. When analysing the major topics that prompt a greater cooperative sentiment towards water events in the media, it is clear that there are five main topics that are focused on: development, meetings, hydropower, bilateral cooperation and multilateral cooperation (Figure 5c). Development, meetings and hydropower all are key topics, accounting for 22.22% of topic relevance to articles.

4.3 Dynamics of Conflictive and Cooperative Sentiments as Perceived within and beyond the Basin

Conflictive and cooperative sentiment as reflected within and beyond the basin countries was calculated to reveal detailed insights into the evolving perspectives, as seen in Figure 6a. It was observed that from 1991 to 2018 there is an apparent trend in increasing cooperative sentiment scores for both international (beyond the basin) and regional (within the basin) publications (Figure 6a). There has also been decreased variability in the average sentiments over time, both international and regional newspaper articles had a similar sentiment score between 2008 and 2018 approximately. The six riparian countries have had a greater average sentiment for cooperation than international countries for the majority of the time scale showing that the region

Formatted: Font: 12 pt, Not Italic

Formatted: Font: 12 pt, Not Italic

Formatted: Font: 12 pt

Formatted: Heading 2, Left

Deleted:

Deleted: events

Deleted: Topic analysis was also conducted in those years that were identified as peaks and troughs. Figure 5 depicts the proportion of topics and most frequent words present in the articles published in year 2004, 2011 and 2015. 2004 is a year of significance for high proportion of cooperation to conflict articles published, with approximately 85% of all articles having a positive sentiment. As per the topic identification and relevance in Figure 5a, main topics reported on during this time were international relations and bilateral and multilateral projects and cooperation under The Greater Mekong Subregion (GMS). One major contributor is the Asian Development Bank (ADB) who provides support to the GMS with the overall objective of poverty reduction, in which the principal path to this is markets development and cross-border transfer of goods and people across borders (ADB, 2004). The multitude of annexes and protocols signed throughout 2004 in regard to a proposed transport facilitation program, with numerous summits and meetings being held within the riparian countries have contributed to the significantly high proportion of cooperative sentiment to conflictive sentiment in year. On the other hand, the high proportion of cooperation score in this year can be also attributed to the absence of often negatively perceived events, i.e. dam infrastructure. ¶
The year 2011 was a considerable trough as there is a significant drop in the sentiment proportion with a greater percentage of conflictive articles. This was due to a dramatic increase in the number of articles published concerning the controversial Xayaburi dam which was identified as one of the most frequent words in Figure 5b. The major contributing factor of the conflictive sentiments in this year is the criticism it received from both riparian countries and international community for the potential impacts of the dam as well as the wrongful consultation process. Finally, in 2015 there was a higher proportion of cooperation articles to conflict. The main topics identified in the articles published in 2015 are multilateral cooperation and meetings, encompassing four out of the ten identified topics. This is also corroborated in the word cloud in Figure 5c where the most frequent words are [3]

Formatted: Font color: Dark Red

Deleted: 2

Deleted:

Deleted: on Dynamic

Deleted: by Each

Deleted: Country

Deleted: S

Deleted: scores for each country

Deleted: of each country

Deleted: 6

Deleted: 6

Deleted: states

perceived transboundary water management in the Lancang-Mekong River Basin more positively than global audiences. This figure also highlights some of the key players in transboundary river basin management for the Lancang-Mekong region such as Australia and the United States of America (Figure 6b). Both Australia and the United States of America are development partner of the region and thus positively involved in the water management. Philippines is one of the major publication places for the Asian Development Bank (ADB) which is a key player for funding and international aid and has been frequently mentioned in the publications.

4.3 Dynamics of Conflictive and Cooperative Sentiments as Perceived from Each Riparian Country

Most importantly, Figure 7 shows the average sentiment scores for each of the riparian countries from 1991 until 2018. The results showed that all riparian countries demonstrated mostly cooperative sentiment relating to water events in Lancang-Mekong River Basin with overall average sentiments scores from each riparian country in order of lowest to highest are Cambodia (0.13), Thailand (0.34), Laos (0.46), Myanmar (0.58), China (0.86) and Vietnam (0.91). Upstream riparian countries, such as China, Laos, and Myanmar, are exhibiting more positive sentiments compared to the downstream countries, Cambodia and Thailand (Figure 7). However, one major outlier is Vietnam, the most downstream country, which exhibits the highest sentiment value among all riparian countries. With the exception of Vietnam's sentiment score, the trend shows that countries further downstream show more conflictive sentiments. China has also consistently expressed very positive sentiments relating to water events in Lancang- Mekong River Basin over time (Figure8). Upon inspection into the articles from China, predominantly published by Xinhua News, the Lancang-Mekong Cooperation (LMC) is a common occurrence in the text that contributes China's positive outlook on transboundary river basin management in the region. Thailand presents similar results, except for one year, 2011, which shows a negative average sentiment score. Laos' average sentiment scores between 2007 and 2018 are very variable and do not seem to follow any certain trend. Cambodia showed predominantly negative average sentiment scores as fishing issues has been a concerned issue cited in newspaper throughout the

Formatted: Heading 2, Left, Right: -0.01 cm

Formatted: Font: 12 pt, (Asian) Chinese (China)

Deleted: Within the riparian states, upstream riparian countries, such as China, Laos, and Myanmar, are exhibiting more cooperative sentiments compared to the downstream countries, Cambodia and Thailand (Figure 6b). However, one major outlier is Vietnam, the most downstream country, which exhibits the highest sentiment value among all riparian countries. With the exception of Vietnam's sentiment score, the trend shows that countries further downstream show more conflictive sentiments. This figure also highlights some of the key players in transboundary river basin management for the Lancang-Mekong region such as Australia, the United States of America, and the Philippines. Both Australia and the United States of America are development partner of the region and thus positively involved in the water management. Philippines is one of the major publication places for the Asian Development Bank (ADB) which is a key player for funding and international aid and has been frequently mentioned in the publications. ¶ ¶

Deleted: 7

Deleted: . However, one major outlier is Vietnam, the most downstream country, which constantly exhibited the positive sentiment.

study period. Myanmar has minimal data with only 32 articles were found in total, and only one year, 2014, has shown a negative average sentiment score.

5. Discussion and Conclusion

Understanding conflictive or cooperative responses is critical for establishing effective governance and policies for natural resources. It is important to understand the change of sentiments toward shared transboundary water resources to be able to understand their cooperative or non-cooperative behaviour, the factors that encourage and discourage changes toward cooperation or conflict. This paper develops a new perspective to understand the evolution of conflict and cooperation dynamics with in-depth analysis multiple countries. Key findings of this study are summarised below.

The overall sentiment analysis in correspondence with the current literature depicts a current trend of overly cooperative sentiments towards water events occurring within the region. This is consistent with the previous studies in which the dominant trend in media coverage analysis was the decreasing of cooperative events from 1948 to 2008 (De Stefano et al., 2010). This research was also able to bridge the gap in the literature and depict the continual trends that the proportion of cooperative to conflictive articles has begun to stabilize and started to rise in favour of cooperative events. There are several reasons for this trend to occur. Firstly, between 1948 and 1999, extensive headway was made towards cooperative actions with the establishment of the MRC with all lower Mekong countries and the adoption of associated treaties and agreements throughout its duration (Yorth, 2014). Moreover, the majority of negative publications are associated with dam infrastructure and development as per Figure 5, which is also reflective of the worldwide transboundary rivers with infrastructure and water quantity being identified as key controversial issues (De Stefano et al., 2010). Therefore, with an absence of dam proposals and construction prior to the 1990s and hence a significant source of conflict was absent during this time (Yorth, 2014). The general concerns associated with infrastructure development along a river including limited sediment flow, lower water quality, the effect on fish species and the livelihoods of people who rely on the river, were not overly present without the threat of infrastructure

Formatted: Paragraph

Deleted: value

Deleted: aimed to

Deleted:

Deleted: ing of

Deleted: in Lancang-Mekong River Basin

Deleted: of the perspectives of

Deleted: ¶

Deleted: There was also a number of projects in operation outside the MRC including the "Quadripartite Economic Cooperation (QEC)" with China, Laos, Myanmar, and Thailand in 1993, the Indicative Basin Plan published in 1970 and the signing of the agreement on the "Cooperation for the Sustainable Development of the Mekong River Basin" in 1995 (Yorth, 2014).

(Network, 2009). There is also a likely decline in the percentage of positive articles due to the fact that the Lower Mekong Basin countries were experiencing civil and regional wars throughout the 1970s to 1980's (Wilson, 2014). As the majority of finances, infrastructure and strategic focus was devoted to the war during these times, there were no major projects or developments occurring along the Lancang-Mekong River, contributing to the overall positive perspective of the region.

By identifying the perspectives of different types of water events, trends begin to emerge regarding the frequency of topics resulting in either greater positive or negative sentiments. It was found that the majority of water events that are negatively reported on are associated with dam infrastructure (see Figure 5b) and thus, this is likely a major contributor to conflict for the Lancang-Mekong River Basin. This could be attributed to a variety of reasons. Historically, for all transboundary river systems, infrastructure and water quantity have been the most contested events occurring in rivers for their ability to completely alter the current water system and the significant downstream and upstream impacts (De Stefano et al., 2010). Primarily, major concerns over the construction of dams is associated with water quantity and the effects this has on sediment flux changes, water discharge, fisheries and water access for irrigation and agriculture (Yorth, 2014). Throughout the history of all dam proposals and construction in the Lancang-Mekong, it is found that not just the construction and operation of the dam that received a significant amount of negative media attention but also the proposal and planning process. Therefore, to ensure this pattern of conflict over dam infrastructure is minimized in the future, investments need to be made in promoting the duty to notify, conducting proper consultation programs and producing impact assessments available publicly. It was also found that that the greatest events that are positively reported on by the media are those that aid in connecting leaders and project developers between riparian countries including meetings, bilateral and multilateral cooperation and development projects. Development is also generally viewed positively in the media due to the potential for desired growth and is promoted by many international NGOs including the ADB. In fact, the ADB aided in the establishment of the Greater Mekong Subregion Economic Cooperation in 1992 to focus on nine priority areas of economic growth along the

Moved (insertion) [5]

Field Code Changed

Lancang-Mekong: transport, telecommunications, energy, tourism, human resources development, environment, agriculture, trade, and investment (Krongkaew, 2004). Thus, development is considered a crucial topic and action in providing greater cooperation and collaboration between riparian countries. By allowing this continual interaction and joint projects that facilitate riparian countries considering all interests and impacts on a larger, transboundary river scale, there is great potential for future cooperation to solve the current issues within the Lancang-Mekong Basin.

This study also differentiates between international countries and regional countries in how each topic is perceived by the media differently, whether riparian is overly critical of water events or view them from a more cooperative perspective than international countries. This understanding can allow for greater collaboration in realizing individual concerns of each country and distributing funding and aid accordingly and ultimately create greater collaborative water management schemes. It was found that regional countries on average have a higher cooperative sentiment score than international countries in each year from 1991 to 2018. This is likely associated with the topics that are considered 'newsworthy' to be published in a regional area, pertaining to another country. Generally speaking, when countries report on events not occurring within their close proximity and in different countries, they do so to focus on the major and complex issues and relationships that occur across the globe (Lewis, 2010). Hence, foreign news often focuses on significant instances of either great cooperative events such as international freshwater treaties and major strategic alliances, or significantly conflictive events including extensive war acts and hostile interactions of both physical and verbal nature (De Stefano et al., 2010). Given that 38.3 % of the total number of topics reported on are associated with meetings, bilateral relations, multilateral relations, joint management programs and local water resources as identified in Figure 5a, it is likely that these topics were not as 'newsworthy' or significantly cooperative or conflictive enough to be reported on consistently by international countries.

With the exception of Vietnam's sentiment score, the trend shows that countries further downstream showed lower positive sentiments. It was predicted that Vietnam and Cambodia would express negative sentiments, however, these expectations were not met in the study. The

Deleted: ¶

Deleted: -critical

Moved up [5]: By identifying the perspectives of different types of water events, trends begin to emerge regarding the frequency of topics resulting in either greater positive or negative sentiments. It was found that the majority of water events that are negatively reported on are associated with dam infrastructure (see Figure 4b) and thus, this is likely a major contributor to conflict for the Lancang-Mekong River Basin. This could be attributed to a variety of reasons. Historically, for all transboundary river systems, infrastructure and water quantity have been the most contested events occurring in rivers for their ability to completely alter the current water system and the significant downstream and upstream impacts (De Stefano et al., 2010). Primarily, major concerns over the construction of dams is associated with water quantity and the effects this has on sediment flux changes, water discharge, fisheries and water access for irrigation and agriculture (Yorth, 2014). Throughout the history of all dam proposals and construction in the Lancang-Mekong, it is found that not just the construction and operation of the dam that received a significant amount of negative media attention but also the proposal and planning process. Therefore, to ensure this pattern of conflict over dam infrastructure is minimized in the future, investments need to be made in promoting the duty to notify, conducting proper consultation programs and producing impact assessments available publicly. It was also found that that the greatest events that are positively reported on by the media are those that aid in connecting leaders and project developers between riparian countries including meetings, bilateral and multilateral cooperation and development projects. Development is also generally viewed positively in the media due to the potential for desired growth and is promoted by many international NGOs including the ADB. In fact, the ADB aided in the establishment of the Greater Mekong Subregion Economic Cooperation in 1992 to focus on nine priority areas of economic growth along the Lancang-Mekong: transport, telecommunications, energy, tourism, human resources development, environment, agriculture, trade, and investment (Krongkaew, 2004). Thus, development is considered a crucial topic and action in providing greater cooperation and collaboration between riparian countries. By allowing this continual interaction and joint projects that facilitate riparian countries considering all interests and impacts on a larger, transboundary river scale, there is great potential for future cooperation to solve the current issues within the Lancang-Mekong Basin.¶

reason behind this pattern is that the true perspectives of some riparian countries including Vietnam and Cambodia could not be analysed as not many regional newspapers from those countries were accessible through Lexis-Nexis and as a result hinders the conclusions made. This is also one of the major limitations of this study that only English newspapers published in regional and international countries that are accessible through LexisNexis database were included for analysis. For future research it is imperative that a greater variety of newspaper sources covering local languages are utilized through using multiple newspaper databases in order to gain a representative analysis of the perspectives of all riparian countries.

In conclusion, the future of the Lancang-Mekong is reliant on the riparian countries to collaboratively manage these resources. If the cooperative water events continue to increase and the issues associated with negative events can be collaboratively identified, managed and overcome, there is great potential for the region to achieve effective transboundary water management. As Kofi Annan, Secretary-General of the United Nations argued in 2002, "… the water problems of our world need not be only a cause of tension; they can also be a catalyst for cooperation…If we work together, a secure and sustainable water future can be ours" (Wolf, 2007).

Code/Data availability

The data is available on request from the corresponding author (tianfq@mail.tsinghua.edu.cn).

Author contribution

Jing Wei, Yongping Wei and Fuqiang Tian designed research framework. Jing Wei, Natalie Nott and Claire de Witt collected data, conducted manual data sorting, and data analysis. Liying Guo and You Lu revised the code for data analysis. Jing Wei, Yongping Wei and Fuqiang Tian prepared the manuscripts with contributions from all co-authors.

Competing interests

The authors declare that they have no conflict of interest.

Acknowledgements

We would like to acknowledge the National Key Research and Development Programme of China (2016YFA0601603) for the funding and support of this research.

Reference

Bengston, D. N., Fan, D. P., and Celarier, D. N.: A new approach to monitoring the social environment for natural resource management and policy: The case of US national forest benefits and values, Journal of Environmental Management, 56, 181-193, 1999.

Bennett, N. J., and Dearden, P.: Why local people do not support conservation: Community perceptions of marine protected area livelihood impacts, governance and management in Thailand, Marine policy, 44, 107-116, 2014.

Caldas, M. M., Sanderson, M. R., Mather, M., Daniels, M. D., Bergtold, J. S., Aistrup, J., Stamm, J. L. H., Haukos, D., Douglas-Mankin, K., and Sheshukov, A. Y.: Opinion: Endogenizing culture in sustainability science research and policy, Proceedings of the National Academy of Sciences, 112, 8157-8159, 2015.

Chen, X., Wang, D., Tian, F., and Sivapalan, M.: From channelization to restoration: Sociohydrologic modeling with changing community preferences in the Kissimmee River Basin, Florida, Water Resources Research, 52, 1227-1244, 2016.

Cooper, S. D.: Bringing Some Clarity to the Media Bias Debate, Review of Communication, 5, 81-84, 2005.

Curtin, M.: Chinese media and globalization, Chinese Journal of Communication, 5, 1-9, 2012.

Danneman, N., and Heimann, R.: Social media mining with R, Packt Publishing Ltd, 2014.

De Stefano, L., Edwards, L., de Silva, A., and Wolf, L.: Tracking cooperation and conflict in international basins: historic and recent trends, Water Policy, 12, 10.2166/wp.2010.137, 2010.

Di Baldassarre, G., Viglione, A., Carr, G., Kuil, L., Salinas, J., and Blöschl, G.: Socio-hydrology: conceptualising human-flood interactions, Hydrology and Earth System Sciences, 17, 3295, 2013.

Di Baldassarre, G., Sivapalan, M., Rusca, M., Cudennec, C., Garcia, M., Kreibich, H., Konar, M., Mondino, E., Mård, J., and Pande, S.: Sociohydrology: Scientific challenges in addressing the sustainable development goals, Water Resources Research, 55, 6327-6355, 2019.

Dinar, A.: Exploring Transboundary Water Conflict and Cooperation, Water Resources Research, 40, 10.1029/2003wr002598, 2004.

Dore, J.: The governance of increasing Mekong regionalism, Social Challenges for the Mekong Region. White Lotus, Bangkok, 405-440, 2003.

Dugan, P. J., Barlow, C., Agostinho, A. A., Baran, E., Cada, G. F., Chen, D., Cowx, I. G., Ferguson, J. W., Jutagate, T., and Mallen-Cooper, M.: Fish migration, dams, and loss of ecosystem services in the Mekong basin, Ambio, 39, 344-348, 2010.

Elshafei, Y., Sivapalan, M., Tonts, M., and Hipsey, M.: A prototype framework for models of socio-hydrology: Identification of key feedback loops with application to two Australian case-studies, Hydrology and Earth System Sciences Dis- cussions, 11, 629-689, 2014.

Gleick, P. H.: The human right to water, Water policy, 1, 487-503, 1998.

Grey, D., and Sadoff, C.: Beyond the river: The benefits of cooperation on international rivers. Grey, D. (Ed.), 2002.

Hartley, T. W.: Public perception and participation in water reuse, Desalination, 187, 115-126, 2006.

Hirsch, P., and Cheong, G.: Natural Resource Management in the Mekong River Basin: Perspectives for Australian Development Cooperation, A Final Report to AusAID, University of Sydney, Sydney. Sydney, Australia: University of Sydney. Available at: http://sydney. edu …, 1996.

Hurlimann, A., and Dolnicar, S.: Newspaper coverage of water issues in Australia, Water Research, 46, 6497-6507, https://doi.org/10.1016/j.watres.2012.09.028, 2012.

Kandasamy, J., Sounthararajah, D., Sivabalan, P., Chanan, A., Vigneswaran, S., and Sivapalan, M.: Socio-hydrologic drivers of the pendulum swing between agricultural development and environmental health: a case study from Murrumbidgee River basin, Australia, Hydrology and Earth System Sciences, 2014.

Krongkaew, M.: The development of the Greater Mekong Subregion (GMS): real promise or false hope?, Journal of Asian Economics, 15, 977-998, 2004.

Larson, K. L., White, D. D., Gober, P., Harlan, S., and Wutich, A.: Divergent perspectives on water resource sustainability in a public–policy–science context, Environmental Science & Policy, 12, 1012-1023, 2009.

Lewis, D.: Foreign correspondents in a modern world: The past, present and possible future of global journalism, The Elon Journal of Undergraduate Research in Communications, 1, 119-127, 2010.

Li, J., Dong, S., Peng, M., Yang, Z., Liu, S., Li, X., and Zhao, C.: Effects of damming on the biological integrity of fish assemblages in the middle Lancang-Mekong River basin, Ecological Indicators, 34, 94-102, 2013.

McCracken, M., and Wolf, A. T.: Updating the Register of International River Basins of the world, International Journal of Water Resources Development, 35, 732-782, 10.1080/07900627.2019.1572497, 2019.

MRC: Summary, State of the Basin Report 2018, VIentiane, Lao PDR, 2019a.

MRC: State of the Basin Report 2018, VIentiane, Lao PDR, 2019b.

Nesbitt, H.: Water used for agriculture in the Lower Mekong Basin, MRC Technical Paper No, 11, 1683-1489, 2005.

Mekong Mainstream Dams Threatening Southeast Asia's Food Security: https://www.internationalrivers.org/sites/default/files/attached-files/mekong_mainstream_aug09.pdf, 2009.

Neuendorf, K. A.: The content analysis guidebook second edition, USA: Cleveland State University, 2017.

Nielsen, F. Å.: A new ANEW: Evaluation of a word list for sentiment analysis in microblogs, arXiv preprint arXiv:1103.2903, 2011.

Petersen-Perlman, J. D., Veilleux, J. C., and Wolf, A. T.: International water conflict and cooperation: challenges and opportunities, Water International, 42, 105-120, 2017.

Petersen‐Perlman, J. D., and Wolf, A. T.: Getting to the first handshake: Enhancing security by initiating cooperation in transboundary river basins, JAWRA Journal of the American Water Resources Association, 51, 1688-1707, 2015.

Quesnel, K. J., and Ajami, N. K.: Changes in water consumption linked to heavy news media coverage of extreme climatic events, Science advances, 3, e1700784, 2017.

Racine, E., Waldman, S., Rosenberg, J., and Illes, J.: Contemporary neuroscience in the media, Social science & medicine, 71, 725-733, 2010.

Roberts, M. E., Stewart, B. M., Tingley, D., and Airoldi, E. M.: The structural topic model and applied social science, Advances in neural information processing systems workshop on topic models: computation, application, and evaluation, 2013, 1-20,

Roberts, M. E., Stewart, B. M., Tingley, D., Lucas, C., Leder‐Luis, J., Gadarian, S. K., Albertson, B., and Rand, D. G.: Structural topic models for open‐ended survey responses, American Journal of Political Science, 58, 1064-1082, 2014.

Roobavannan, M., Van Emmerik, T. H., Elshafei, Y., Kandasamy, J., Sanderson, M. R., Vigneswaran, S., Pande, S., and Sivapalan, M.: Norms and values in sociohydrological models, Hydrology & Earth System Sciences, 22, 2018.

Sunchindah, A.: Lancang-Mekong River Basin: Reflections on cooperation mechanisms pertaining to a shared watercourse, S. Rajaratnam School of International Studies., 2013.

Tian, F., Liu, H., Hou, S., Li, K., Lu, H., Ni, G., Mu, X., and Baiyinbaoligao: Drought Characteristics of Lancang-Mekong River Basin and the Impacts of Reservoir Regulation on

Streamflow, Tsinghua University and China Institute of Water Resources and Hydropower Research, 2020.

Turner, R. A., Fitzsimmons, C., Forster, J., Mahon, R., Peterson, A., and Stead, S. M.: Measuring good governance for complex ecosystems: perceptions of coral reef-dependent communities in the Caribbean, Global Environmental Change, 29, 105-117, 2014.

van Emmerik, T. H. M., Li, Z., Sivapalan, M., Pande, S., Kandasamy, J., Savenije, H. H. G., Chanan, A., and Vigneswaran, S.: Socio-hydrologic modeling to understand and mediate the competition for water between agriculture development and environmental health: Murrumbidgee River basin, Australia, Hydrol. Earth Syst. Sci., 18, 4239-4259, 10.5194/hess-18-4239-2014, 2014.

Watson, N., Deeming, H., and Treffny, R.: Beyond Bureaucracy? Assessing Institutional Change in the Governance of Water in England, Water Alternatives, 2, 2009.

Weaver, D. A., and Bimber, B.: Finding news stories: a comparison of searches using LexisNexis and Google News, Journalism & Mass Communication Quarterly, 85, 515-530, 2008.

Wei, J., Wei, Y., Western, A., Skinner, D., and Lyle, C.: Evolution of newspaper coverage of water issues in Australia during 1843–2011, Ambio, 44, 319-331, 2015.

Wei, J., Wei, Y., and Western, A.: Evolution of the societal value of water resources for economic development versus environmental sustainability in Australia from 1843 to 2011, Global Environmental Change, 42, 82-92, 2017.

Wilson, W. T.: Beating the middle-income trap in Southeast Asia, The Heritage Foundation, August, 27, 2014.

Wolf, A., Yoffe, S., and Giordano, M.: International Waters: Identifying Basins at Risk, Water Policy, 5, 29-29, 10.2166/wp.2003.0002, 2003.

Wolf, A. T.: The Transboundary Freshwater Dispute Database Project, Water International, 24, 160-163, 10.1080/02508069908692153, 1999.

Wolf, A. T., Natharius, J. A., Danielson, J. J., Ward, B. S., and Pender, J. K.: International river basins of the world, International Journal of Water Resources Development, 15, 387-427, 1999.

Wolf, A. T., Kramer, A., Carius, A., and Dabelko, G. D.: Managing water conflict and cooperation, State of the World 2005: redefining global security, 80-95, 2005.

Wolf, A. T.: Shared waters: Conflict and cooperation, Annu. Rev. Environ. Resour., 32, 241-269, 2007.

CHAPTER 2 BASINS AT RISK: WATER EVENT DATABASE METHODOLOGY: http://www.transboundarywaters.orst.edu/research/basins_at_risk/bar/BAR_chapter2.pdf 2001.

Yoffe, S., Wolf, A. T., and Giordano, M.: Conflict and cooperation over international freshwater resources: Indicators of basins at risr 1, JAWRA Journal of the American Water Resources Association, 39, 1109-1126, 2003.

Yorth, B.: International Mekong River Basin: Events, Conflicts or Cooperation, and Policy Implications, Master of Public Policy, Oregon State University, 2014.

Zawahri, N. A.: Capturing the nature of cooperation, unstable cooperation and conflict over international rivers: the story of the Indus, Yarmouk, Euphrates and Tigris rivers, International Journal of Global Environmental Issues, 8, 286-310, 2008.

Zeitoun, M., and Mirumachi, N.: Transboundary water interaction I: reconsidering conflict and cooperation, International Environmental Agreements: Politics, Law and Economics, 8, 297-316, 10.1007/s10784-008-9083-5, 2008.

List of Figure Captions

Deleted: ¶

Formatted: Line spacing: Double

Deleted: Outline of the Data Retrieval Process and Coding for Sentiment Analysis and Structural Topic Modelling

Deleted: Figure 1. The location of the Lancang-Mekong River, the main river pathway and its tributaries across the six riparian countries (Tian et al., 2020)¶
Figure 2. Outline of the Data Retrieval Process and Coding for Sentiment Analysis and Structural Topic Modelling¶

Formatted: Line spacing: Double

Deleted: Figure 3. The Number of articles published pertaining to water events along the Lancang-Mekong River Basin (a); the proportion of the number of overall positive and negative articles (b)¶

Formatted: Line spacing: Double

Deleted: Figure 5. Frequency of Topics identified in all articles published in the year 2004 calculated using STM analysis (a); Frequency of Topics identified in all articles published in the year 2011 calculated using STM analysis (b); Frequency of Topics identified in all articles published in the year 2015 calculated using STM analysis (c)¶
Figure 6. The Average Sentiment Score of Regional and International Newspapers from 1991 to 2018 (a) and number of articles published relating to water events in the Lancang-Mekong River Basin, average sentiment score for each country (excluding countries with no data), and number of publication sources as denoted by the bubble size (b)¶

1233 Table 1 The Search Terms Established to Generate Results

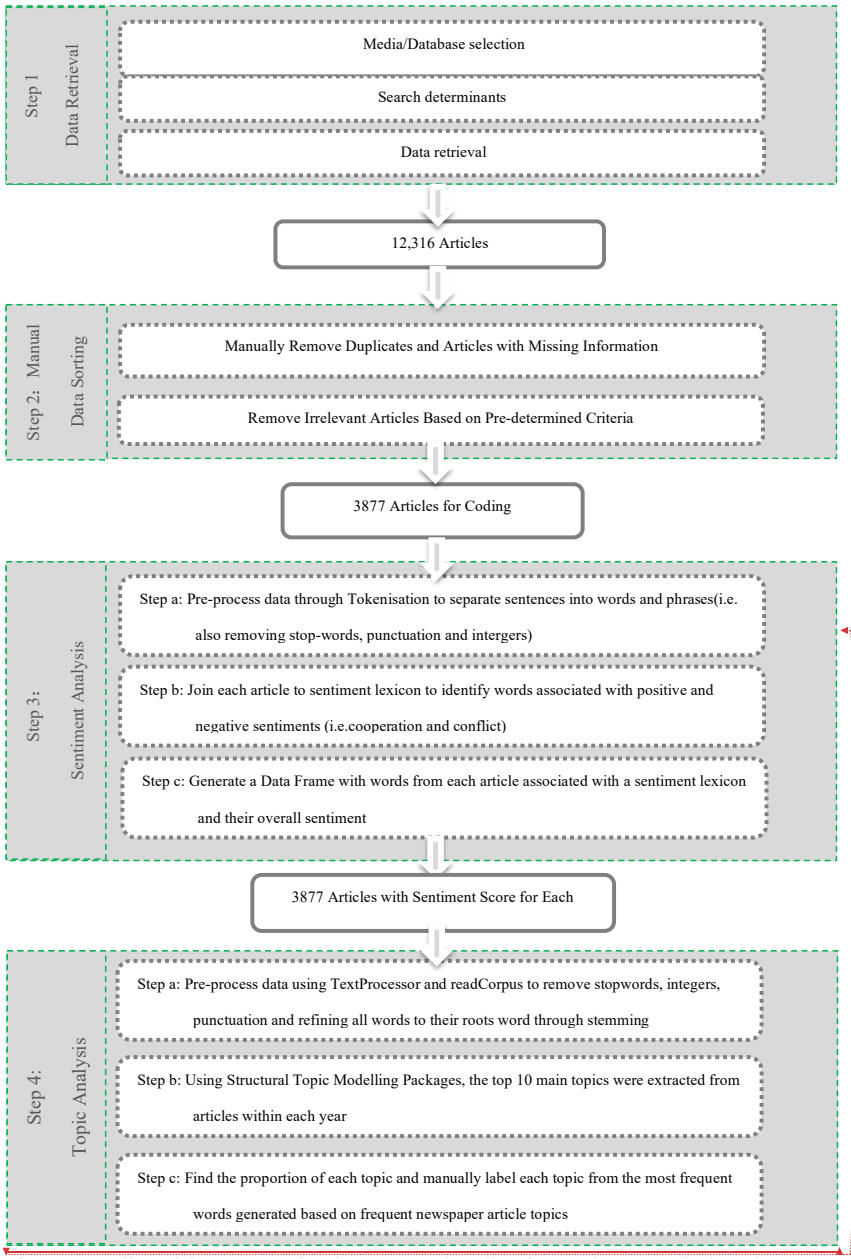
Lexis Nexis Requirements	Key Word Search
Must Include the words:	Mekong
Includes at least one of the following words related to **water**:	water* or river* or lake* or dam* or stream* or tributar* or diversion* or irrigati* or polluti* or "water quality" or flood* or drought* or channel*
Includes at least one of the following words related to **conflict/cooperation**:	treat* or agree* or negotiat* or resolution* or commission* or secretariat* or "joint management" or "basin management" or "peace accord" or settle* or cooperat* or collaborat* or dispute* or conflict* or disagree* or sanction* or war* or troop* or "letter of protest" or hostil* or "shots fired" or boycott* or protest*
Includes at least one of the following words related to **countries involved**:	Thai* or Cambodia* or China or Chinese or Lao* or Myanmar* or Burm* or "viet nam" or Vietn*
Does not include any of the following words:	sea, ocean, navigation, nuclear, "water cannon", "light water reactor", "mineral water", "hold water", "cold water", "hot water", "water canister", "water tight", "water down", "flood of refugees", oil, drugs

1234

1235 Table 2 Criteria for inclusion and exclusion of news articles

Criteria for Including Data	Irrigation using the Lancang-Mekong river as a source
	Conflict over water resources: e.g. proposed development
	Cooperation over water resources: e.g. bilateral/multilateral agreements, MRC, ASEAN
	Species affected by development projects: e.g. pollution, water quantity and quality
	Salt intrusion due to decreased water quantity and flow from upstream: e.g. dams/diversions
	Livelihoods affected by use of water resources: e.g. dams, diversions, dam failures, contamination of water
	Flooding or droughts as a result of water release or containment in dams
	Infrastructure development that can affect water resources/species e.g. proposed bridge development, dams, diversions
Criteria for Excluding Data	Tourism not related to the use of water resources by riparian countries: e.g. cruises, blogs, personal recounts
	War: e.g. history of Vietnam War, awarding of medals
	Economic development not related to water resources in Lancang-Mekong River
	Bridges across the Lancang-Mekong River and not referring to effects on water resources
	Tariffs and trade agreements that have no association with water resources
	Border conflicts not pertaining to water resources: e.g. security, border control, land ownership disputes

1236



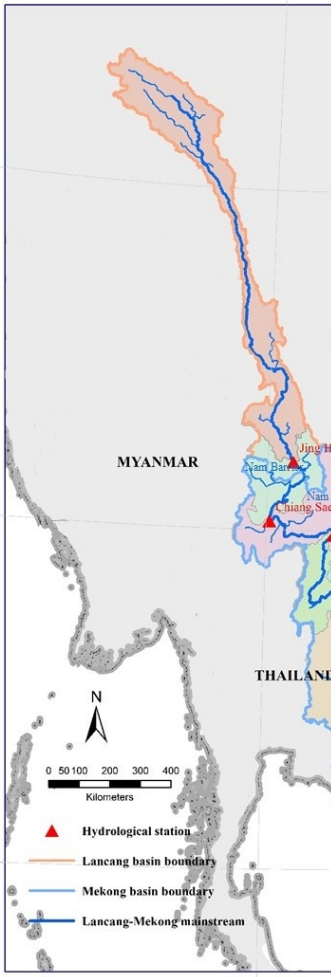


Figure 3 Outline of the Data Retrieval Process and Coding for Sentiment Analysis and Structural Topic Modelling

Deleted:

Formatted: Normal, Left

Formatted: Font: (Asian) Times New Roman, (Asian) Chinese (China), (Other)

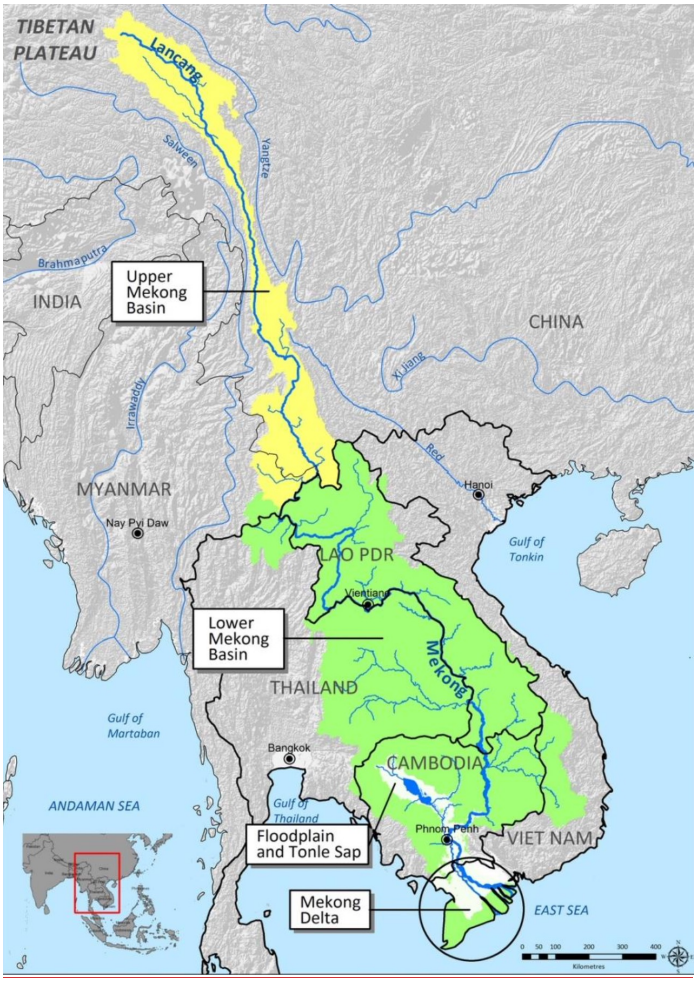


Figure 4 The location of the Lancang-Mekong River, the main river pathway and its tributaries across the six riparian countries (MRC, 2019a)

Deleted: The location of the Lancang-Mekong River, the main river pathway and its tributaries across the six riparian countries (MRC, 2019a)(MRC, 2019a)(Tian et al., 2020)¶ ... [4]

Formatted: Centered

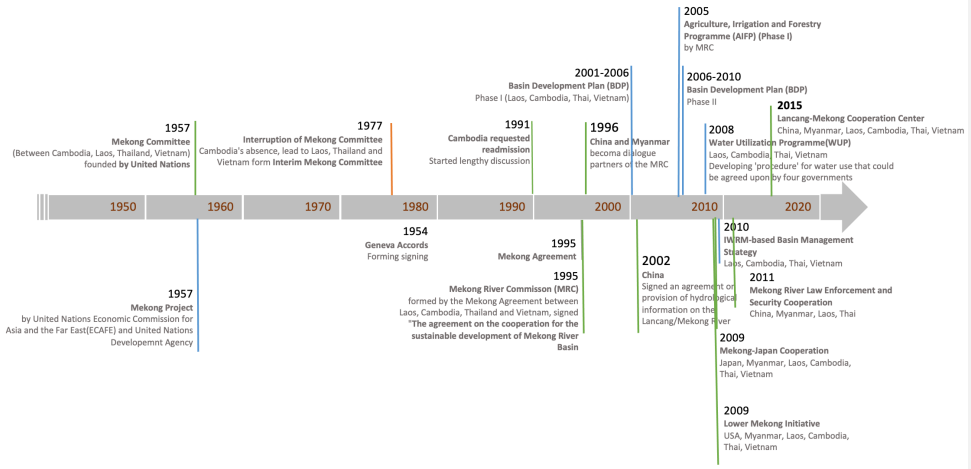


Figure 3 History of Major Events within Lancang-Mekong River Basin

Deleted: Outline of the Data Retrieval Process and Coding for Sentiment Analysis and Structural Topic Modelling

Formatted: (Asian) Chinese (China)

Formatted: Indent: Left: -1 cm

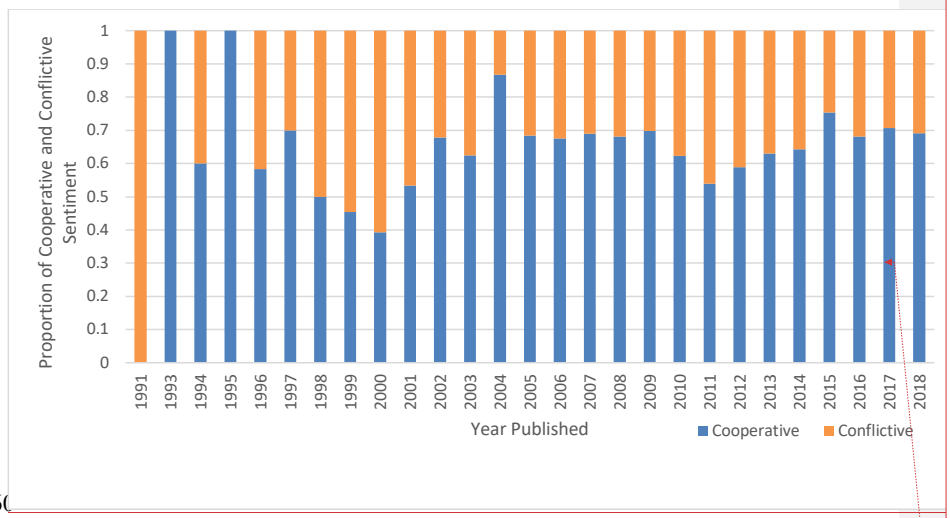
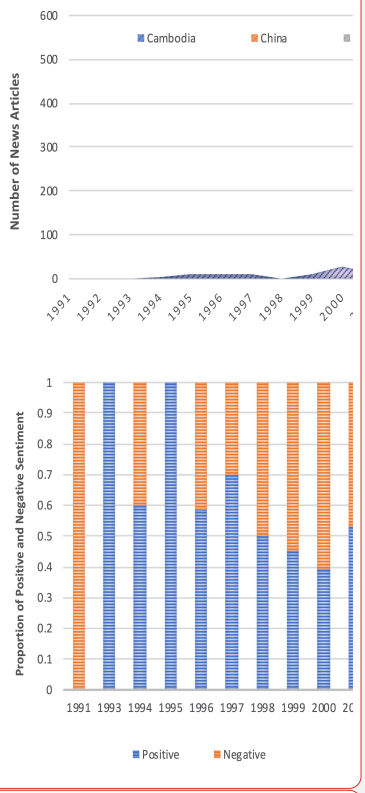


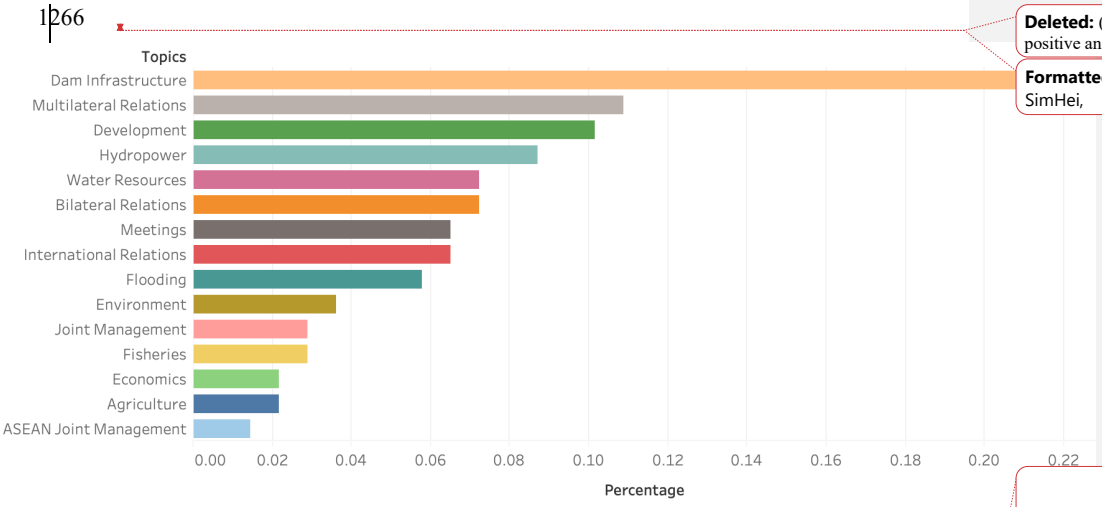
Figure 4 Proportion of Cooperation/Conflict articles published pertaining to water events along the Lancang-Mekong River Basin



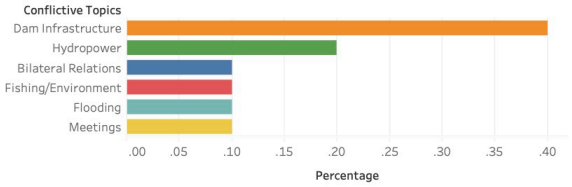
eleted:

Formatted: Indent: Left: -0.75 cm

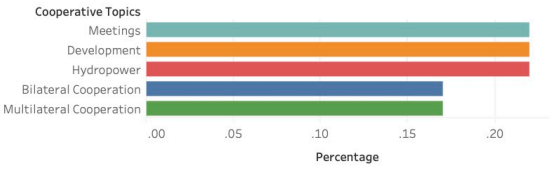
Deleted: The Number of



a

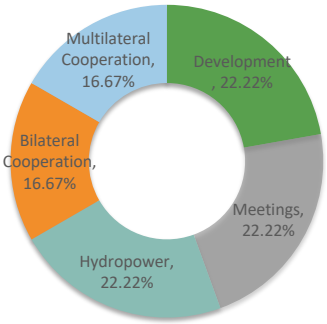


b



c

Figure 5 The proportion of all topics identified as key topics in newspapers from 1991 to 2018 (a); The proportion of Topics Identified within all articles published with an overall conflictive sentiment (b); The proportion of Topics Identified within all articles published with an overall cooperative sentiment (c).



Deleted: (a); the proportion of the number of overall positive and negative articles (b)

Formatted: Font: (Default) +Headings (Cambria), (Asian) SimHei,

Deleted:

Formatted: Indent: Left: 0 cm

Deleted: a

Deleted: a

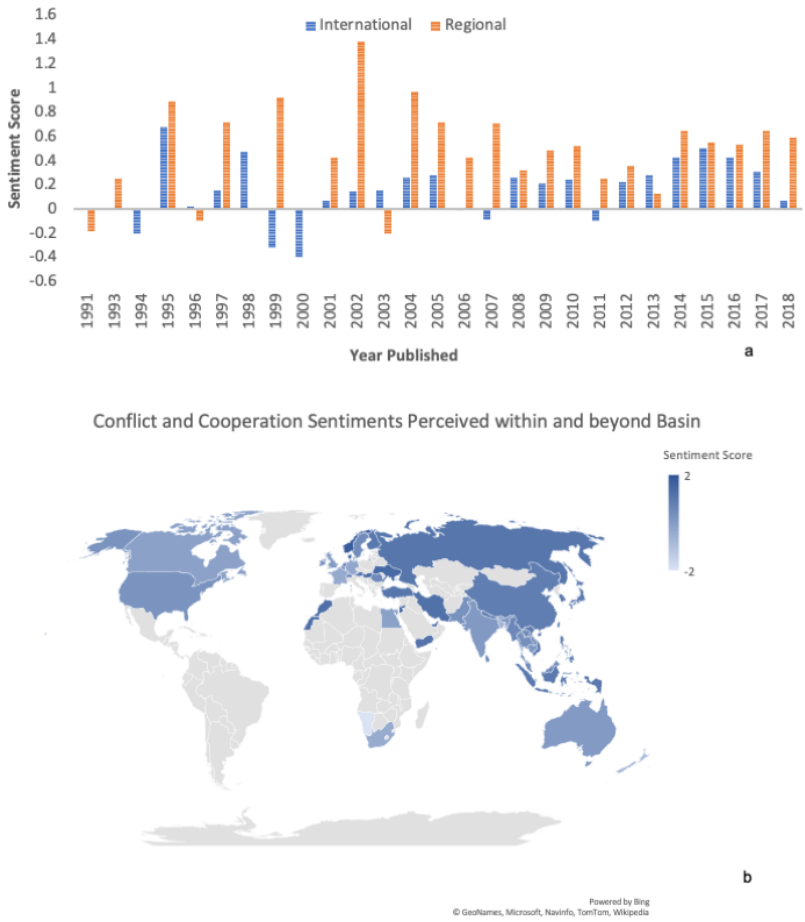


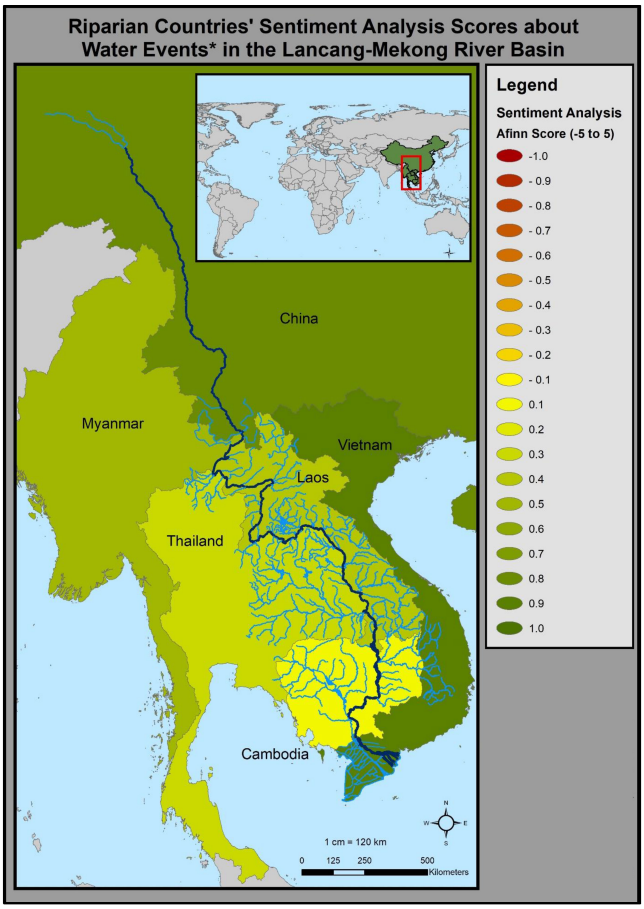
Figure 6 The Average Sentiment Score of Regional and International Newspapers from 1991 to 2018 (a) Conflict and Cooperation Sentiments perceived within and beyond the Basin (b)

Deleted:

Figure 5. Frequency of Topics identified in all articles published in the year 2004 calculated using STM analysis (a); Frequency of Topics identified in all articles published in the year 2011 calculated using STM analysis (b); Frequency of Topics identified in all articles published in the year 2015 calculated using STM analysis (c) ... [5]

Deleted: and number of articles published relating to water events in the Lancang-Mekong River Basin, average sentiment score for each country

Deleted: (excluding countries with no data), and number of publication sources as denoted by the bubble size



Deleted: ¶

¶

¶

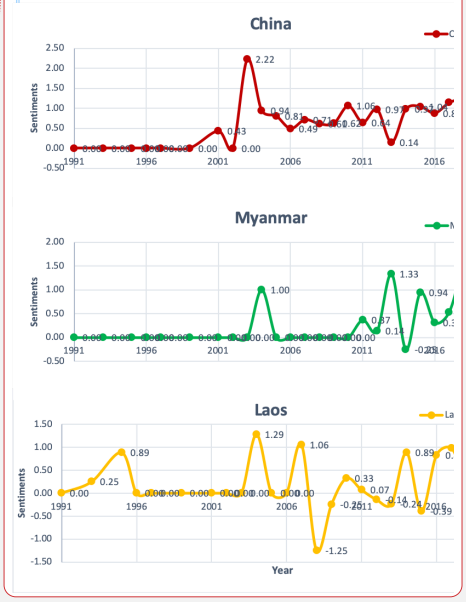


Figure 7 Average Conflict/Cooperation Sentiments Score of Each Riparian Country between 1991 to 2018

Formatted: Indent: Left: 0 cm

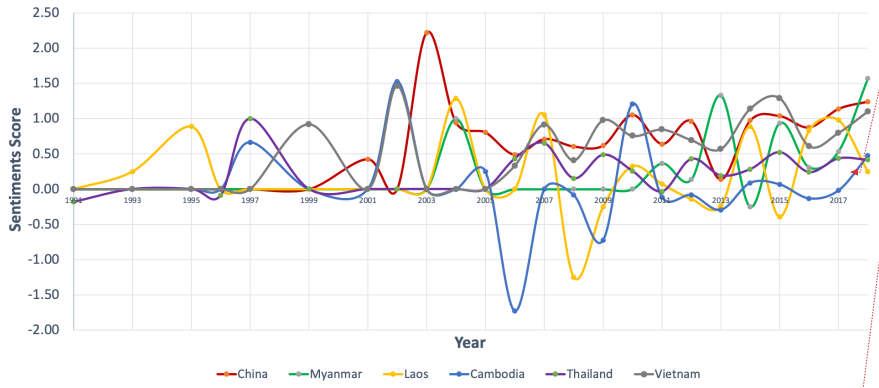


Figure 8 Conflict/Cooperative sentiment scores of the riparian countries (Cambodia, China, Laos, Myanmar, Thailand, and Vietnam) from 1991 until 2018

Formatted: New paragraph, Indent: Left: -0.5 cm, Line spacing: single

Deleted: ¶

Deleted: Average

Deleted: for

Page 5: [1] Deleted	**jing wei**	**12/30/20 3:28:00 PM**

Page 5: [2] Formatted	**jing wei**	**12/31/20 12:46:00 AM**

Paragraph, Left, Indent: Left: 0 cm, First line: 0 cm, Numbered + Level: 1 + Numbering Style:

1, 2, 3, … + Start at: 1 + Alignment: Left + Aligned at: 0.63 cm + Indent at: 1.27 cm

Page 11: [3] Deleted	**jing wei**	**1/1/21 12:39:00 AM**

Page 27: [4] Deleted	**jing wei**	**12/31/20 7:12:00 PM**

Page 31: [5] Deleted	**jing wei**	**12/31/20 7:17:00 PM**