

STRENGTHENING WATER DIPLOMACY THROUGH WATER DATA SHARING AND INCLUSIVE EVIDENCE-BASED TRANSBOUNDARY GOVERNANCE

Research Report



AUTHORS:

Carl Middleton
Anisa Widyasari
Kanokwan Manorom
David J. Devlaeminck
Apisom Intralawan



About the Center for Social Development Studies

The Center for Social Development Studies (CSDS) within the Faculty of Political Science of Chulalongkorn University produces critical interdisciplinary research on social development in Southeast Asia, engages in policy-making through building partnerships, and provides a public forum for debating critical issues. (www.csds-chula.org)

About the Cambodia Development Research Institute

Cambodia Development Resource Institute (CDRI) was established in 1990 with a mission to enhance human capacities in Cambodia and to undertake research and analysis contributing to sustainable development policies and strategies. Since its establishment, acting with basic respect for local capacity, CDRI has strived to build on local knowledge and experience, working in partnership with public institutions, private sector and civil society in planning and implementing its activities. Grounded in research in Cambodia, CDRI has offered meaningful development alternatives appropriate to Cambodia's real needs. Now, approximately 30 years later, CDRI is Cambodia's leading development policy research institute. It has seen significant changes as an institution and in its Cambodian environment and context. (www.cdri.org.kh)

Acknowledgements:

The researchers would like to thank all of the interviewees who generously provided their time to answer our questions. This research was conducted with the generous support of the Lancang-Mekong Cooperation Fund (LMCF) managed by the Cambodia Development Research Institute.

Cover image

Front: A small fishing boat in low water on the Mekong River. (Credit: Kanokwan Manorom).

Back: Two boats rest on the Mekong River. (Credit: Massimo Lama via Getty Images)

This report

This report was written by Carl Middleton, Anisa Widyasari, Kanokwan Manorom, David J. Devlaeminck and Apisom Intralawan. It was published in August 2021. The report, together with additional resources, are available for download at www.csds-chula.org/water-diplomacy-in-the-mekong-basin. The views expressed in this report are those of the authors, and do not necessarily reflect the policy or position of the LMCF.

For further details, please contact Carl.M@chula.ac.th.

Suggested citation

Middleton, C., Widyasari, A., Manorom, K., Devlaeminck, D.J. and Intralawan, A. (2021) *Strengthening water diplomacy through water data sharing and inclusive evidence-based transboundary governance*. August, 2021. Center for Social Development Studies, Faculty of Political Science, Chulalongkorn University, and Cambodia Development Research Institute: Bangkok and Phnom Penh.

Table of Contents

04	Acronyms
05	List of Tables
06	Executive summary
10	Introduction
12	Methodology
14	Water Data Sharing: International Best Practice
14	Background on International Law
15	Convention on the Law of the Non-Navigational Uses of International Watercourses (1997)
17	Convention on the Protection and Use of Transboundary Watercourses and International Lakes (1992)
19	Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy (WFD)
22	Good Practice Guidelines for Water Data Management Policy
24	Water data sharing on the Mekong–Lancang River
24	Water data sharing between MRC member states
29	Water data sharing between China and the MRC
32	Water data sharing via the Lancang Mekong Cooperation framework
36	Web-based Water Data Sharing Platforms
40	Drought, low flows and water data politics (2019–2020)
43	Empirical case studies on community-level access to water data in Thailand
43	Water data on Thai government websites
44	Northern Thailand
47	Northeastern Thailand
51	Discussion
51	Comprehensive and accessible scientific water data
52	Diversity of water knowledge
52	Deepening water diplomacy and institutionalizing transboundary accountability
53	Conclusion and Policy Directions: Water data sharing and accountable transboundary governance for improved water diplomacy
60	Appendix: References

Acronyms

ACMECS	Ayrewaddy–Chaophraya–Mekong Economic Cooperation Strategy
CIWRHR	China Institute of Water Resources and Hydropower Research
DoF	Department of Fisheries
DWR	Department of Water Resources
ESIA	Environmental and Social Impact Assessment
EU	European Union
GMS	Greater Mekong Subregion
JEM	Joint Environment Monitoring of Mekong Mainstream Hydropower Projects
HLPW	High Level Panel on Water
IWMI	International Water Management Institute
IWRM	Integrated Water Resources Management
LMC	Lancang–Mekong Cooperation
LMRB	Lower Mekong River Basin
LMWRCC	Lancang–Mekong Water Resources Cooperation Centre
MRC	Mekong River Commission
MRC-IS	MRC – Information System
MRC-WUMS	MRC – Water Use Monitoring System
MWDI	Mekong Water Data Initiative
MUSP	Mekong US Partnership
ONWR	Office of National Water Resources
PDIES	Procedures for Data and Information Exchange and Sharing
PMFM	Procedures for Maintenance of Flows on the Mainstream
PNPCA	Procedures for Notification, Prior Consultation and Agreement
PWUM	Procedures for Water Use Monitoring
PWQM	Procedures for Water Quality Monitoring
RDFMC	Regional Flood and Drought Management Centre
RID	Royal Irrigation Office
SDG	Sustainable Development Goal
SEA	Strategic Environmental Assessment
TNMC-IS	Thai National Mekong Committee Information System
UN	United Nations
UNECE	United Nations Economic Commission for Europe
Watercourses Convention	1997 United Nations Convention on the Law of Non-navigational Uses of International Watercourses
Water Convention	1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes
Water Framework Directive	Directive 2000/60/EC of the European Parliament and of the Council Establishing a Framework for the Community Action in the Field of Water Policy
WFD	Water Framework Directive

List of Tables

Table 1	Summary of key informant interviews in Thailand
Table 2	Text and notes on the Watercourses Convention
Table 3	Text and notes on the Water Convention
Table 4	Text and notes on Water Framework Directive
Table 5	Notifications from China to MRC on water level changes since 2019
Table 6	Information sharing in LMC documents
Table 7	Comparison of regional web-based water data sharing platforms

A photograph of a sunset over a river. The sun is a bright, glowing orb in the upper left, casting a long, shimmering reflection down the center of the water. In the foreground, a fishing net is visible, its frame and mesh silhouetted against the bright light. The background shows a line of trees on the far bank under a soft, orange-hued sky.

EXECUTIVE SUMMARY

This report focuses on water data sharing and transboundary water governance on the Mekong-Lancang River. It examines the role and actions of state actors, intergovernmental institutions including the Mekong River Commission (MRC) and the Lancang-Mekong Cooperation (LMC), and non-state actors including riparian communities, civil society, academics, and think tanks. It addresses the following research question: “What options exist for improved evidence-based transboundary water governance between state actors and inclusive of non-state actors in the Mekong-Lancang basin building from recent improvements in basin-wide water data sharing?”

This report outlines customary international law and existing conventions/directives on transboundary rivers, namely the 1997 Watercourses Convention, the 1992 Water Convention, and the EU Water Framework Directive. It also summarizes the Good Practice Guidelines for Water Data Management Policy. Across these agreements, sharing water data is a foundational component of generating evidence and analysis to attain equitable and reasonable utilization of transboundary water resources, and is also necessary to fulfill the due diligence obligation not to cause significant harm. Moreover, across the good practices surveyed, the availability of data and information to the public is generally favored, given that it can increase trust by the public in state-facilitated decisioning making, increase public participation, and support sustainable development.

This report details existing water data sharing arrangements: between the MRC member states; between China and the MRC; and via the LMC. Water data and information sharing are at the center of the MRC’s mandate and activities. A series of Procedures have been progressively approved by the MRC member states that facilitates intergovernmental data sharing, and much of this data as well as the scientific

analysis that it informs is publicly available via the MRC data portal. Water data sharing between China and the MRC has also progressively expanded since 2002, and since November 2020 is at its most extensive with hourly water data shared twice per day from two monitoring stations that is published on both the MRC's and LMC's websites. Within the LMC framework the member states have also committed to "data and information sharing" among a range of project and activities, including launch of the Lancang-Mekong Water Resources Cooperation Centre (LMWRCC) Information Sharing Platform in December 2020. Overall, the extent of water data and information shared between the region's governments and made available to the public via online platforms has expanded over time resulting in improved transparency. However, the water data shared is not complete, with important gaps being only partial water data for the upper portion of the basin in China and on the operation and mitigation measures of mainstream and tributary hydropower projects throughout the upper and lower basin. These gaps create uncertainty on the status and explanation of river conditions in the Mekong-Lancang basin, especially at times of drought and low flows, and flooding.

The report also analyzes the hydropolitics of river low flows during 2019–2020, with particular attention to how these hydropolitics were influenced by research published at the time, and intensified by geopolitical tensions between the US and China. A study based on satellite data on the 2019 drought by Basist and Williams (2020) led to intense debate over the role of mainstream hydropower projects in China, including among researchers as well as in the media and political arenas. The announcement in October 2020 that China would make available all-year-round water data from two monitoring stations on the Lancang River partly addressed data gaps identified at the time, although there remains

scope for China to expand water data sharing still further.

The report also presents empirical evidence from two case studies in North and Northeast Thailand. Interviewees had observed unseasonal changes in the river since a decade ago, in terms of water level, color and flow, which had affected river and wetland ecosystems and their fishing and riverbank gardening practices and livelihoods. For example, from our interviews with riparian community representatives in Northeast Thailand, since 2019 episodes of low sediment loads due to low flows and accompanying clear 'aqua blue' water resulted in the rapid growth of green algae that clogged up fishing nets and created extra work to clean them before fishing again. Boats also become stranded on rocky outcrops and riverbanks when low flows arrive quickly that then require extra time and labor to move them back into the river. It has been challenging for these communities to respond to the river's changes, and they have not found an effective channel to communicate their difficulties and situational knowledge to Thai government agencies, and regional institutions such as the MRC and LMC. It was also perceived that long-term solutions are required that are beyond the immediate control and capacity of individual riparian communities.

The report details two Thai-language government-managed online water data platforms. However, our community level interviews found that few people used these platforms directly nor the MRC or LMWRCC platforms at present. Rather, people living in riparian communities tend to circulate information among themselves in person or via Facebook or LINE sourced from mass media, civil society groups, and other fishers or boat operators. For riparian communities, more important than real-time water level data was receiving advanced warnings on changing water levels and its consequences, which at present many interviewees

considered to be not timely nor accurate.

The report's analysis and conclusions highlight three themes and offers policy directions for each. First, there is a positive trend by governments towards making more scientific water data and information publicly accessible on web-based platforms and via more comprehensive portals, although there are still important gaps in this water data. This cooperation has been based on progressively deeper agreements between member states of the MRC, and also between China and the MRC. The scientific data shared is especially of value to government agencies, researchers and various types of think tanks who undertake research, analysis and modeling of the Mekong-Lancang River. High quality research can generate information for decision-making in transboundary water governance, including within impact assessment tools such as environmental and social impact assessment and strategic environmental assessment. Despite these improvements, there remains a lack of clarity on under what conditions advanced warning will be communicated by China to the MRC on changing river conditions, and how these can be effectively communicated to riparian communities to prepare for and accommodate the river changes predicted. There have also been recent cases of the politicization of research that can undermine the long-term credibility of evidence generated by scientific studies. Key policy directions are:

- Continue to expand the geographical scope, number of monitoring stations and comprehensiveness of scientific water data shared between governments and placed in the public domain via the MRC and LMC data portals, including: on the Lancang River to cover all eleven hydropower dams; the operation of tributary projects throughout the basin; and from the Mekong mainstream dams in Laos now in operation.
- Work towards an additional intergovernmental agreement between

China and the MRC to clarify the specific parameters and timeframes for sharing advanced warning on changing river conditions.

- Conduct research on how to pro-actively communicate emergency information simply, quickly and effectively to riparian communities.
- Deepen legislation on impact assessment tools into water and energy related decision-making processes, systematically connecting them to public participation processes. MRC member states could also approve the Procedures on Transboundary Environmental Impact Assessment.
- Scientific research undertaken by government agencies, researchers and various types of think tanks should be publicly accountable, for example by presentation in research conferences and/or undergoing processes of peer review.

Second, it is now widely recognized that for inclusive and sustainable development to take place, multiple forms of knowledge are required in addition to 'scientific knowledge', including situated community knowledge, civil society-led research, as well as political and practical forms of knowledge. The emphasis on water data sharing to date has been on scientific analysis between governments, to be shared with the public. The scope of this discussion could be expanded to recognize the value of exchanging and combining multiple forms of water knowledge that would strengthen relationships and trust between state and non-state actors, improve public participation, and co-produce new actionable water knowledge. Key policy directions are:

- Establish mechanisms within the MRC and LMC platforms, as well as national government agencies, to receive and deliberate analysis from communities, civil society, think tanks and others as a basis for ongoing exchange of knowledge

and public participation in transboundary water governance

- Research funding agencies should support community-led, civil society, academic, and think tank research to ensure that diverse forms of knowledge are produced that can contribute information to decision-making in transboundary water governance.
- Government agencies working at the provincial and national levels should work together and routinely visit local areas to inform people in riparian villages about water data and listen to their concerns.
- Develop research initiatives in which state and non-state actors can meaningfully collaborate to co-produce integrative transboundary knowledge, including research on community-level impacts of changing river conditions, and research that integrates and triangulates scientific water data with the situational knowledge of riparian communities, local and regional government officers and civil society combining the expertise of all actors. Collaboration between academic institutes in the region could facilitate such a regional research agenda.

Third, there is growing interest in the role of water diplomacy in the Mekong-Lancang basin, which are commonly understood as state-to-state processes to resolve transboundary water issues through intergovernmental dialogue and cooperation including through diplomatic channels beyond those that engage in water management at the technical level. To date, water diplomacy has focused on setting in place agreements for water data sharing within the MRC and between China and the MRC. Yet, increased transparency through the availability of water data does not in itself result in changed practices on managing water infrastructure that is accountable to

affected riparian communities, civil society and the wider public. Some MRC Procedures have been established to facilitate notification, prior consultation and agreement between MRC member States on water infrastructure projects, and that include a degree of public participation. In contrast, there is not presently a clear rules-based regime in place on the operation of hydropower projects on the Lancang River that would establish accountability mechanisms between the operation of the cascade and its downstream impacts. Key policy directions are:

- Deepen intergovernmental discussion on establishing a clear and institutionalized rules-based regime for the entire Lancang-Mekong basin that is founded on meaningful dialogue, reciprocity and trust between states and with riparian communities and civil society. A starting point could be a joint study on the existing legal rules, customary principles, pledges, and regional agreements (such as the MRC's Procedures) maintained by each state actor to identify points of commonality and difference to then examine how these could structure basin-wide rules-based cooperation.
- Water data sharing and transboundary accountability of water infrastructure should incorporate mechanisms for meaningful participation of people living in riparian communities and other actors including civil society groups, academics and think tanks.
- Through deepening water diplomacy and rules-based institutionalization, work basin-wide towards restoring a minimum natural hydrological regime in collaboration with riparian communities that minimizes the impacts of hydropower dam operation on ecosystems and wetlands.



eranyardeni / "boat on the mekong river by sunset" via Getty Images

INTRODUCTION

The Mekong–Lancang River flows from headwaters in the Qinghai–Tibetan Plateau through Yunnan Province of China, Myanmar, Laos, Thailand, Cambodia and Vietnam. Since the early 1990s, a growing number of large hydropower dams have increased storage capacity in the basin, in the process changing the river’s hydrology and ecology at scales ranging from the local to the transboundary (Räsänen et al., 2017, MRC, 2019e). These have occurred alongside other river development projects including for navigation and large-scale irrigated agriculture. Climate change is also influencing the river’s hydrology and ecosystems, with implications for human activities (Evers and Pathirana, 2018).

Transboundary water governance is complex in the Mekong–Lancang basin given the diverse range of state and non-state actors’ interests (Dore et al., 2012). Two key intergovernmental institutions structuring transboundary water governance are the Mekong River Commission (MRC) and the Lancang–Mekong Cooperation (LMC) (Middleton and Allouche, 2016). The MRC is a treaty-based intergovernmental organization founded in 1995 between Cambodia, Laos, Thailand and Vietnam, with China and Myanmar as dialogue partners. The LMC was launched in March 2016 and includes all six states of the Mekong–Lancang basin, with water resources management as one of five priority areas. These two institutions exist in the context of over ten other regional frameworks, including the Greater Mekong Subregion (GMS) and Ayeyawaddy–Choaphraya–Mekong Economic Cooperation Strategy (ACMECS) that also influence less-directly transboundary water governance (Middleton et al., 2019a).

Severe droughts including in 2009–2010, 2015–2016, and 2019–2021, together with other impacts such as changing water quality, algae growth, and rapidly changing water levels, have foregrounded the importance of regional cooperation and water diplomacy in the Mekong–Lancang basin (Kittikhoun and Staubli, 2018, Mirumachi, 2020). There is ongoing debate regarding the extent to which large dam infrastructure in the basin has exacerbated the impact of the drought in the region, or could have been operated differently to better mitigate its impacts (Kallio and Fallon, 2020). A focus of this debate has been on the upstream dams in China, where eleven projects have been progressively built on the mainstream since the

early 1990s. However, in October 2019 the first lower Mekong mainstream dam – the Xayaburi Dam in Northern Laos – was commissioned, and the project’s operation rules and environmental monitoring data are yet to be publicly available (MRC, 2020c). The most recent low flows since 2019 have coincided with previously unencountered river conditions in some downstream areas in the form of an ‘aqua-marine blue’ water color, algae blooms, and low sediment suspension (MRC, 2019a).

During 2020, several regional and international research and think tank groups published studies on the issues of drought, low river flows and hydropower dam operation in the Mekong-Lancang basin that generated intense regional debate, as well as media reporting (Basist and Williams, 2020, Kallio and Fallon, 2020, Ketelsen et al., 2020b, MRC, 2020d, Tian et al., 2020a). A key challenge of all existing studies – as well as other commentary – has been the incomplete availability of basin-wide water data. At the time of these reports, hydrological data sharing for flood and drought conditions only occurred all year round between the four MRC member states, while China shared hydrological data with the MRC during the flood season and under emergency conditions during the dry season. In the context of the 2020 drought and the debate generated, in August 2020 the MRC published a situation report that emphasized the importance of basin-wide data sharing to clarify the basin conditions including the role that large dams may play in low flows (MRC, 2020b), which was also echoed by several downstream states as well as a range of civil society groups. In October 2020, China announced year-round state-to-state water data sharing commencing in November 2020 (MRC, 2020a).

In this research report, we focus on transboundary water data sharing, which has emerged as a key policy concern. Water

data sharing is the foundation of evidence-based cooperation, trust building, and ultimately positive reciprocity in water diplomacy. The report’s main research question is:

“What options exist for improved evidence-based transboundary water governance between state actors and inclusive of non-state actors in the Mekong-Lancang basin building from recent improvements in basin-wide water data sharing?”

The report is structured as follows. In section 2, the research method is outlined. In section 3, an assessment is made of the current status of international good practice on water data sharing. In section 4, the existing water data sharing arrangements in the Mekong-Lancang basin are evaluated. In section 5, an analysis is made of how the availability of water data and its analysis has influence hydropolitics and geopolitics in the Mekong-Lancang basin during the 2019–2020 drought. In section 6, empirical evidence is presented on how transboundary water data is shared with and acted on by non-state actors in Northern and Northeastern Thailand, in particular within riparian communities. In section 7, the report presents an analysis based on three themes: the availability of comprehensive and accessible scientific water data; the diversity of water knowledge; and on deepening water diplomacy and institutionalizing transboundary accountability. In section 8, the report concludes by discussing how does existing water data sharing arrangements in the Mekong-Lancang basin contribute to evidence-based transboundary water governance, and what policy options exist for strengthening transboundary water governance that facilitates evidence-based transparent and accountable transboundary water decisions.

METHODOLOGY

To assess international good practice on water data sharing in international law literature review and legal analysis was conducted on key international agreements, namely: the 1997 United Nations Convention on the Law of Non-navigational Uses of International Watercourses (Watercourses Convention); the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention); and the EU Water Framework Directive (section 3). We also outline the key elements of the non-binding Good Practice Guidelines on Water Data Management Policy (Bureau of Meteorology, 2017).

To assess current water data and information sharing in the Mekong-Lancang basin we analyze the institutionalized arrangements: 1) between MRC member states; 2) between the LMC and MRC; and 3) through the LMC. We compliment this with a comparative analysis of the three existing water data portals hosted by the MRC, LMC, and the Mekong US Partnership (MUSP) on: type of data and information shared; governance; and public access. We extend this analysis by more briefly assessing three other current data sharing platforms, namely: www.MekongWater.org; www.OpenDevelopmentMekong.net; and the Stimson Center's Mekong Infrastructure Tracker (www.stimson.org/project/mekong-infrastructure).



To assess the current means by which water data is shared between states and with the public and its impact on hydropolitics and geopolitics, we conduct a literature review analysis of the recent droughts and low flows between 2019 and 2021. This analysis is complimented by two empirical case studies researched in Ubon Ratchathani Province and Chiang Rai Province, Thailand. Both case studies are in areas where a significant proportion of the community members depend upon river resources and are affected by changes in water levels/ water quality. A summary of the key informant interviews is in Table 1 below:

Table 1: Summary of key informant interviews in Thailand

	Chiang Rai Province	Ubon Ratchathani Province and Nong Khai Province
Government officers	3	2
Private sector	2	-
Community and civil society representatives	4	15 + one focus group discussion with 16 community representatives
Local authorities	-	2
Academics	-	1

In Chiang Rai Province, key informant interviews were conducted with: representatives from the Department of Water Resources (DWR), the Marine Department, and Chiang Saen Port; a hotel owner and a tour operator; a representative of the local authorities in Chiang Saen District; and four community leaders/ civil society leaders from Chiang Saen District and Wiang Chiang Khong. The interviews were conducted during January to March 2021.

In Ubon Ratchathani Province, key informant interviews were conducted with: representatives from the Ubon Ratchathani Provincial Royal Irrigation Office (RID) and the Ubon Ratchathani Provincial Department of Fisheries (DoF); two representatives from local district authorities in Phosai and Khong Chiem districts of Ubon Ratchathani Province; 9 community members residing in a village located next to the Mekong river in Phosai District; 4 community members from Nong Kai Province; one civil society staff from Ubon Ratchathani Province, and one civil society staff from Nongkai Province; and a fishery expert based at Ubon Ratchathani University. These interviews were conducted in February 2021. In addition, one focus group discussion with 16 key informants was held on 28 January 2021 in a riverside village in Phosai District of Ubon Ratchathani Province.

Water Data Sharing: International Best Practices

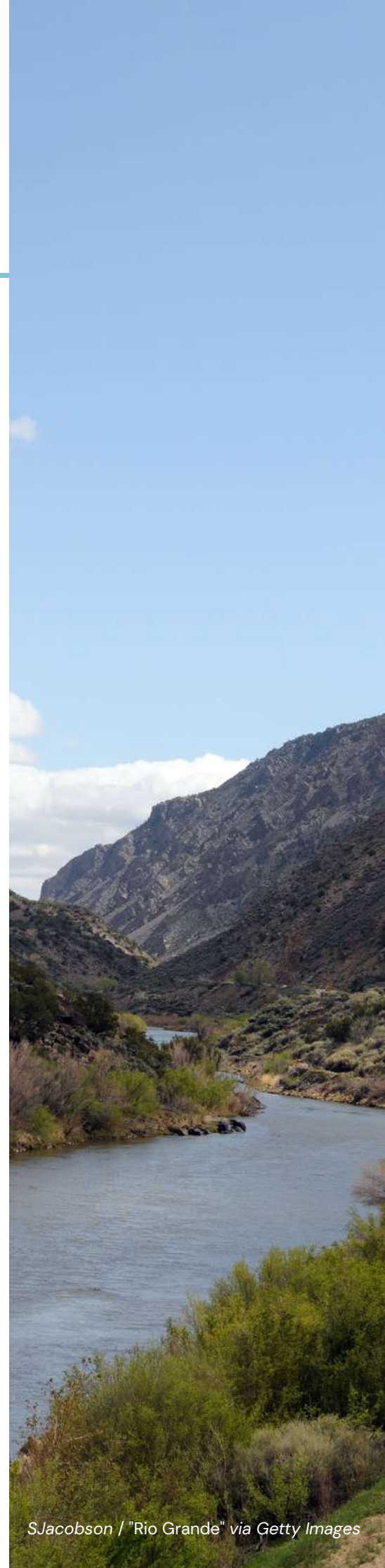
Background on International Law

The law of international watercourses provides a framework through which States can cooperate and jointly manage their shared water resources. However, international water law has historically been defined by conflicting views regarding the rights and obligations of States. Prior to the establishment of customary international law⁽ⁱ⁾, which began to emerge in the 1950s, there were two primary views of transboundary water resources, *absolute territorial sovereignty* and *absolute territorial integrity*.

Absolute territorial sovereignty was preferred by upstream States as it prioritizes upstream uses. In essence, absolute territorial sovereignty claims that States can utilize a shared water resource as it sees fit as the water is within the territory of that State. This is exemplified by the 19th century Rio Grande dispute between the USA and Mexico, where the USA claimed that it could freely utilize the waters of the Rio Grande without considering Mexico's rights or needs.

Absolute territorial integrity does the opposite. Preferred by downstream States as it prioritizes downstream uses, it claims that upstream States cannot utilize waters within their territory as it flows into the downstream State. Although not related to water resources, the most notable example is the 1925 Trail Smelter case in which smoke from a smelter damaged crops and forests in the USA. The USA claimed that the State's sovereignty is supreme and that its territory can be "enjoyed without interference from an outside source."

Neither of these concepts, however, are tenable with regards to transboundary water resources, as these claims ultimately deny the right of other riparians to utilize water resources within their own territory and the inevitability of some level of impact upon them. While States may continue to make these claims as advocacy tools, given the interconnectivity and extreme importance of transboundary



SJacobson / "Rio Grande" via Getty Images

water resources to all States, a third claim emerged – *limited territorial sovereignty*. Emphasizing the dual nature of sovereignty as providing both rights and responsibilities, limited territorial sovereignty recognizes the equal rights of all riparian States to utilize a shared water resource. This claim is reflected in the two foundational rules of international water law, both of which are recognized as customary international law – equitable and reasonable utilization and the due diligence obligation not to cause significant harm. Together, they provide that States have a right to utilize transboundary water resources, but must do so in an equitable and reasonable manner. Furthermore, States must undertake due diligence to prevent significant harm to their transboundary neighbors.

These two rules are codified in the global water conventions, the 1997 Watercourses Convention, Articles 5–7, and the 1992 Water Convention, Articles 2(1 & 2c) (see sections 3.2 and 3.3 respectively). These global water conventions are widely recognized as mutually supportive. In order to successfully implement these rules, however, States require information regarding the condition of the shared water resources in riparian States. As such, the exchange of data and information has become a fundamental procedural rule found in transboundary water agreements around the world, most notably in both global water conventions, the EU Water Framework Directive (section 3.4), and the non-binding Good Practice Guidelines on Water Data Management Policy (section 3.5), as analyzed below.

Convention on the Law of the Non-Navigational Uses of International Watercourses (1997)

After a process of significant study by the International Law Commission that began in 1970, the draft of the Watercourses Convention was adopted at the United Nations General Assembly in 1997. While the draft was adopted with significant support (103 States in favor; 3 votes against; 27 abstentions), the Convention was slow to collect the 35 ratifications necessary to enter into force. This threshold was met in 2014 with Vietnam’s accession to the Convention, which is also significant to the current study given Vietnam’s downstream position in the Mekong-Lancang basin. It currently has 37 State parties, and some of its provisions are widely recognized as codifications of customary international law that would be binding on non-parties. Under a general duty to cooperate (Art. 8), States parties are to share information according to the following provisions (Table 2):

Table 2: Text and Notes on the Watercourses Convention

<i>Text of the Convention</i>	<i>Notes</i>
<p>Article 9</p> <p>1. Pursuant to Article 8, watercourse States shall on a regular basis exchange readily available data and information on the condition of the watercourse, in particular that of a hydrological, meteorological, hydrogeological and ecological nature and related to the water quality as well as related forecasts.”</p>	<p>States are under an obligation to share “readily available information” on a “regular basis”. While neither of these terms are defined in the Convention, it is understood that States are to share information that is already at its disposal in an ongoing and systematic process. While this provision lists specific types of information that States are to share, this list is not exhaustive and instead</p>

only offers examples of types of data that may be important.

2. If a watercourse state is requested by another watercourse state to provide data or information that is not readily available, it shall employ its best efforts to comply with the request but may condition its compliance upon payment by the requesting state of the reasonable costs of collecting and, where appropriate, processing such data or information.

In cases where a State has been requested to provide information that is not readily available, then that State shall make best efforts to comply in good faith⁽ⁱⁱ⁾, but may predicate its provision of information based on reasonable payment.

3. Watercourse states shall employ their best efforts to collect and, where appropriate, to process data and information in a manner which facilitates its utilisation by the other watercourse states to which it is communicated.

In cases where a State has been requested to provide information that is not readily available, then that State shall make best efforts to comply in good faith, but may predicate its provision of information based on reasonable payment.

Article 11

Watercourse States shall exchange information and consult each other and, if necessary, negotiate on the possible effects of planned measures on the condition of an international watercourse.

Closely linked to Article 9, States are under an obligation to notify regarding their planned measures and their possible effects. This includes an exchange of information regarding the planned measure. States shall also consult with each other, and even negotiate on the potential effects of the planned measures. Planned measures are understood broadly, encompassing any new projects or changes to previous uses. If a conflict of interests is identified in this process, then States are to enter into a process of negotiation. This does not require agreement, but a consideration in good faith of all interests affected by the planned measures.

Article 31

Nothing in the present Convention obliges a watercourse state to provide data or information vital to its national defence or security. Nevertheless, that state shall cooperate in good faith with the other watercourse states with a view

While States are obligated to share information (Art. 9), this obligation does not require a State to share any information that would be "vital to its national defence or security". While this term is not defined in the Convention, it

to providing as much information as possible under the circumstances.

commonly refers to information of a strategic or military nature. Determination of the nature of information is based upon the principle of good faith, and States should provide as much information as possible.

Convention on the Protection and Use of Transboundary Watercourses and International Lakes (1992)

The Water Convention was originally negotiated as a pan-European framework under the auspices of the UNECE. In 2016 following an amendment, the Convention was opened to accession globally, meaning that States outside of the UNECE region could accede to the Convention. It currently has 45 States parties and many more have indicated their interest in acceding to the Convention in the future. In relation to their obligation to cooperate (Art. 2), States are also under a general obligation to share information (Art. 6) “as early as possible on issues covered by the provisions of this convention.” These provisions include (Table 3):

Table 3: Text and Notes on the Water Convention

Text of the Convention

Notes

Article 8

Protection of Information

The provisions of this Convention shall not affect the rights or obligations of Parties in accordance with their national legal systems and applicable supranational regulations to protect information related to industrial and commercial secrecy, including intellectual property, or national security.

In sharing information, States are able to protect information related to industrial and commercial secrecy, including both intellectual property and national security. This, however, must be interpreted in a restrictive sense especially when it relates to pollution discharge in transboundary water resources.

Article 9

Bilateral and Multilateral Cooperation

2. The agreements or arrangements mentioned in paragraph 1 of this article shall provide for the establishment of joint bodies. The tasks of these joint bodies shall be, inter alia, and without prejudice to relevant existing agreements or arrangements, the following:

- (c) To draw up inventories and exchange information on the pollution sources mentioned in paragraph 2(a) of this article.

Article 9(1) requires States to enter into bilateral or multilateral agreements or other arrangements. These arrangements must establish joint bodies. Article 9(2) sets out a series of tasks for these joint bodies. This includes sharing information on sources of pollution (c) and that to serve as a hub for information exchange on planned or existing uses, as well as any that “are likely to cause transboundary impact.”

(h) To serve as a forum for the exchange of information on existing and planned uses of water and related installations that are likely to cause transboundary impact.

Article 13

Exchange of Information Between Riparian Parties

1. The Riparian Parties shall, within the framework of relevant agreements or other arrangements according to article 9 of this Convention, exchange reasonably available data, inter alia, on:

- (a) Environmental conditions of transboundary waters;
- (b) Experience gained in the application and operation of best available technology and results of research development;
- (c) Emission and monitoring data;
- (d) Measures taken and planned to be taken to prevent, control and reduce transboundary impact;
- (e) Permits or regulations for waste-water discharges issued by the competent authority or appropriate body.

2. In order to harmonize emission limits, the Riparian Parties shall undertake the exchange of information on their national regulations.

3. If a Riparian Party is requested by another Riparian Party to provide data or information that is not available, the former shall endeavour to comply with the request but may condition its compliance upon the payment, by the requesting Party, of reasonable charges for collecting and, where appropriate, processing such data or information.

States are under an obligation to exchange “reasonably available” information. This is to be understood in a similar manner to “readily available” under the Watercourses Convention, implying that States are to share information that is readily at its disposal.

This provision goes onto include a non-exhaustive list of types of information that are to be exchanged between riparians. In accordance with paragraph 2, this includes information on their national regulations so as to facilitate their harmonization.

In cases where a special request for information is made from one party to another regarding information that is not readily available, the requested riparian is to “endeavour to comply”, but may predicate its collection and provision of information on reasonable payment.

Article 16

Public Information

1. The Riparian Parties shall ensure that

Unlike the Watercourses Convention, the

information on the conditions of transboundary waters, measures taken or planned to be taken to prevent, control and reduce transboundary impact, and the effectiveness of those measures, is made available to the public. For this purpose, the Riparian Parties shall ensure that the following information is made available to the public:

- (a) Water-quality objectives;
- (b) Permits issued and the conditions required to be met;
- (c) Results of water and effluent sampling carried out for the purposes of monitoring and assessment, as well as results of checking compliance with the water-quality objectives or the permit conditions.

2. The Riparian Parties shall ensure that this information shall be available to the public at all reasonable times for inspection free of charge, and shall provide members of the public with reasonable facilities for obtaining from the Riparian Parties, on payment of reasonable charges, copies of such information.

Water Convention includes a provision related to the public availability of specific information, ensuring that the public has access to information on the environment and that States facilitate public awareness and participation. While “the public” is not defined in the Convention, it is to be understood as “any person”.

Riparian States are to ensure information on conditions of transboundary waters, measures (taken or planned) to prevent, control and reduce impact and whether those measures are effective. The provision goes on to provide clarification on the minimum standard for compliance with this provision, indicating three types of information to be made available to the public. When information is released to the public it should be done in a reasonable time and free of charge.

Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy (WFD)

The Water Framework Directive was established in 2000 with the goal of achieving “the elimination of priority hazardous substances” in the marine environment (Preamble, 27). In order to do so, it establishes a framework for the protection of waters that is binding upon EU member States, emphasizing water quality and pollution prevention. While its emphasis is on pollution and quality, the WFD recognizes quantity as an “ancillary element in securing good water quality” (Preamble, 19). In order to fulfill their obligations under the WFD, States are to identify river basins within their territory and designate specific authorities for their management. The various features of the river basin are to be analyzed, and river basin management plans are to be established and implemented. Unlike the global water conventions, there is no specific provision related to information and data exchange. There are, however, a series of provisions relating to monitoring, reporting and public access to information.

Table 4: Text and Notes on Water Framework Directive

<i>Text of the Directive</i>	<i>Notes</i>
<p>Article 8 Monitoring of Surface Water Status, Groundwater Status and Protected Areas</p> <p>Monitoring of surface water status, groundwater status and protected areas</p> <p>1. Member States shall ensure the establishment of programmes for the monitoring of water status in order to establish a coherent and comprehensive overview of water status within each river basin district:</p> <ul style="list-style-type: none"> – for surface waters such programmes shall cover: <ul style="list-style-type: none"> (i) the volume and level or rate of flow to the extent relevant for ecological and chemical status and ecological potential, and (ii) the ecological and chemical status and ecological potential; – for groundwaters such programmes shall cover monitoring of the chemical and quantitative status, – for protected areas the above programmes shall be supplemented by those specifications contained in Community legislation under which the individual protected areas have been established. <p>...</p> <p>3. Technical specifications and standardised methods for analysis and monitoring of water status shall be laid down in accordance with the procedure laid down in Article 21.</p>	<p>Article 8 obliges States to monitor the status of surface and groundwaters by establishing various programmes. It goes on to set out the information that should be covered in such monitoring programmes in surface waters (volume and level/rate of flow, ecological and chemical status/ecological potential), groundwaters (chemical status and quantity), and in protected areas (according to the Community legislation).</p> <p>States are to follow the procedures laid out by the Commission in establishing technical standards for monitoring.</p>
<p>Article 14 Public information and consultation</p> <p>1. Member States shall encourage the active involvement of all interested parties in the implementation of this Directive, in particular in the production</p>	<p>In regards to water resources there are a variety of interested parties. States are obligated to ensure that information collected as part of the WFD are made available to the public. Furthermore, the</p>

review and updating of the river basin management plans. Member States shall ensure that, for each river basin district, they publish and make available for comments to the public, including users:

- (a) a timetable and work programme for the production of the plan, including a statement of the consultation measures to be taken, at least three years before the beginning of the period to which the plan refers;
- (b) an interim overview of the significant water management issues identified in the river basin, at least two years before the beginning of the period to which the plan refers;
- (c) draft copies of the river basin management plan, at least one year before the beginning of the period to which the plan refers.

On request, access shall be given to background documents and information used for the development of the draft river basin management plan.

2. Member States shall allow at least six months to comment in writing on those documents in order to allow active involvement and consultation.

3. Paragraphs 1 and 2 shall apply equally to updated river basin management plans.

public has the ability to request further information that have been utilized in the development of river basin management plans (as established according to article 13). The WFD sets out specific timelines in regards to public comment so as to ensure active participation.

Article 11(5)

Programme of Measures

Where monitoring or other data indicate that the objectives set under Article 4 for the body of water are unlikely to be achieved, the Member State shall ensure that....

- ... the monitoring programmes are reviewed and adjusted as appropriate...

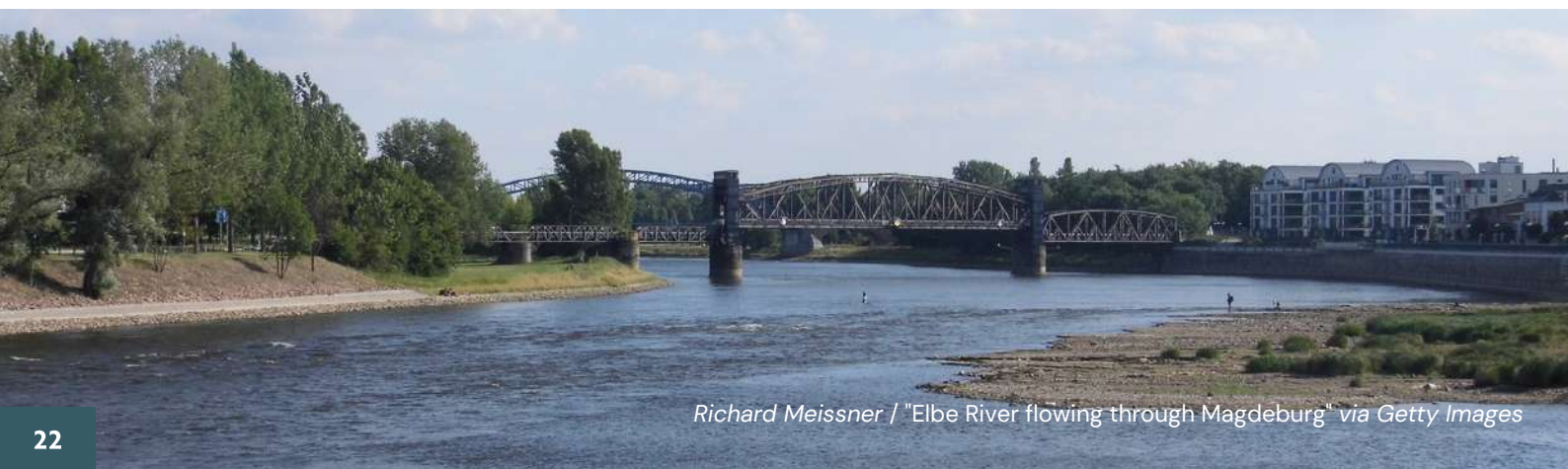
If the objectives of Article 4 – *Environmental Objectives* are not met then State management plans, including monitoring activities, are to be reassessed and altered.

In fulfillment of a State's obligations in Article 8, the WFD sets out three kinds of monitoring in Annex V. This includes *surveillance monitoring* to assess long-term changes, *operational monitoring* to assess the status (and change of status) of waterbodies that risk failing to meet the environmental objectives of the WFD, and *investigative monitoring* in instances where causes of pollution are unknown. Furthermore, in support of information exchange between States, institutions and the public, the European Commission has established the Communication and Information Resource Centre for Administrations, Businesses and Citizens (CIRCABC), an online platform for information sharing between communities. Within this system, the Water Information System for Europe (WISE) was launched in 2007 to provide a web portal entry to water-related information and data on all European waters including pollution, ambient river quality, and groundwater for the public.

Good Practice Guidelines for Water Data Management Policy

The High-Level Panel on Water (HLPW), jointly convened by the United Nations and the World Bank, has recently concluded that water security is one of the risks and strategic challenges confronting humanity. In a Water Action Plan, published in 2016, the HLPW identified sustainable water management can only be realized with rigorous evidence-based decision making, and that in turn requires a solid information base, and reliable water data is a vital pre-requisite for this. In 2017, the HLPW released the World Water Data Initiative Roadmap with a stated objective "To improve cost-effective access to and use of water and hydro-meteorological data by governments, societies and the private sector through policy, innovation and harmonisation". In response to this roadmap, the Good Practice Guidelines for Water Data Management Policy ('Good Practice Guidelines') were prepared to assist government agencies responsible for formulating and implementing strategy to improve water information, with the aim of advancing water policy, planning, management and operations (Bureau of Meteorology, 2017). The study is also conducted in the context of contributing towards attaining SDG6 on clean water and sanitation for all.

The Good Practice Guidelines put forward four reasons why water data sharing can improve water management. First, it can help avoid water shocks that could otherwise come as surprises for which governments are ill-prepared to mitigate their impact. Second, it can enable policy makers to make wise choices based on clear supporting information. Third, it can build trust between water users, including across borders, increasing cooperation and reducing the risk of conflict. Fourth, it can avoid various forms of wastage, both of water itself, as well as investments into inappropriately conceived or designed water infrastructure. They state that: "Investments in water data have been shown to yield very positive financial returns, via significant mitigation of disaster risk, improvements in water use efficiency and cost effective design of water infrastructure."



Richard Meissner / "Elbe River flowing through Magdeburg" via Getty Images

According to the Good Practice Guidelines, there are seven basic uses for water data that most countries are likely to have in common, namely: 1) water assessment, which is the process of describing the water resource and how it is utilized; 2) water evaluation, which is the process of judging the efficacy of water policy settings and management interventions; 3) water operations entail the real-time monitoring of water data parameters for the purposes of operating water infrastructure such as reservoirs, weirs, pipelines and irrigation canals; 4) water foresighting is the process of estimating how water resources and the way that they are used are likely to change in the future; 5) water design entails determining the appropriate design parameters for water infrastructure; 6) water accountability addresses the process by which water managers build trust with customers, investors, regulators, the community and other stakeholders; and 7) water education enables communities to understand where water comes from, how it is managed and how it is used.

The Good Practice Guidelines also consider in detail what constitutes water data, which include meteorological data, river data, groundwater data, water storage data, water use data, water quality data, water pollutant data, waste water data, manufactured water, ecosystem data, water rights data, and administrative data for example on water rights, water pricing, and water management regimes. Consideration is also given to how such data is collected, which includes by direct measurement, inference from remote sensing, and estimation from models, as well as data from various administrative sources.

The Good Practice Guidelines provide expansive details and guidance on elements of good practice water data management.

These can be summarized as encompassing: 1) identifying the priority water management objectives; 2) strengthening water data institutions; 3) establishing sustainable water data monitoring systems; 4) adopting water data standards; 5) embracing an open data approach to water data access and licensing; 6) implementing effective water data information systems; and 7) employing water data quality management processes.

The Good Practice Guidelines offer an expansive argument on the value of 'open data' defined as "data that can be freely used, re-used and redistributed by anyone, subject only, at most, to the requirement to attribute and share alike". They argue that the benefits of open data can include: improving the efficiency of public services; improving data quality; developing innovative services; creating new business models; improving transparency and accountability; and enhancing citizen participation. The guidelines state:

"Governments around the world are turning towards open data approaches and encouraging the use of their data by wide audiences. This follows extensive macroeconomic analyses demonstrating that making data open yields considerable economic and social benefits. Making water data open entails making it easy to discover, download and utilise, and applying an open license that makes it easy to share, remix and use the data."

Public participation is also aligned with the practices of Integrated Water Resources Management (IWRM). As stated in the 1995 Mekong Agreement, IWRM is at the center of the MRC's approach to river basin planning (MRC, 1995).

Water data sharing on the Mekong-Lancang River

Water data sharing between MRC member States

The Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin ('Mekong Agreement') was signed by its four member states Cambodia, Laos, Thailand and Vietnam on 5 April 1995. China and Myanmar have engaged with the MRC as Dialogue Partners since 1996. Article 1 of the Mekong Agreement details a general obligation to cooperate to balance the interests of the parties. Article 4 acknowledges that states will "....cooperate on the basis of sovereign equality and territorial integrity in the utilisation and protection of the water resources of the Mekong River Basin", while Article 5 commits the member states to the principle of reasonable and equitable utilisation.

Maintenance of the dry season mainstream flow has been paid particular attention in the Mekong Agreement (Browder and Ortolano, 2000). Article 6 on the maintenance of flows on the mainstream obligates all states to protect mainstream flows of "not less than an acceptable minimum monthly natural flow" during the dry season, to "enable the acceptable natural reverse flow of the Tonle Sap" during the wet season, and to "prevent average daily peak flows greater than what naturally occurs" in the wet season. To this end, Article 5A states that inter-basin uses and diversions on tributaries of the Mekong River, including Tonle Sap, will be subject to notification to the MRC's Joint Committee. Article 5B states that "On the mainstream of the Mekong River during the wet season Intra-basin use shall be subject to notification to the Joint Committee and Inter-basin diversion shall be subject to prior consultation, while during the dry season Intra-basin use shall be subject to prior consultation" and "Any inter-basin diversion project shall be agreed upon by the Joint Committee through a specific agreement for each project prior to any proposed diversion." Article 7 establishes that all states have reciprocal rights and obligations of no significant harm, with a specific focus on water quantity, quality and ecosystems. These articles in essence entail – and are





founded on – various mechanisms of water data and information sharing between member States.

The process for sharing and managing water-related data and information are detailed in a series of Procedures agreed between the member States. These procedures, however, are outside of the Agreement and are considered to be non-binding (Kinna and Rieu-Clarke, 2017). Water data sharing is addressed in the “Procedures for Data and Information Exchange and Sharing” (PDIES), which was the first Procedure to be adopted by the MRC Council in November 2001 accompanied by the Guidelines on Custodianship and Management of the Mekong River Commission Information System. The objective of PDIES is to “operationalise the data and information exchange among MRC Member Countries; make data and information available for public access as determined by the National Mekong Committees; and promote understanding and cooperation among the Member Countries in a constructive and mutually beneficial manner” (MRC, 2011). PDIES is considered as necessary by the MRC to create a comprehensive knowledge database that can also inform the MRC’s role in facilitating IWRM. Although it led to improved water data sharing, a study that focused on Vietnam found that its initially objectives were not fully achieved as it was hindered by a lack of national regulations in the Vietnam context concerning data sharing between state agencies and outdated information management systems, even though “Vietnam has much to gain and little to lose by engaging in data sharing in the MRC context” (Thu and Wehn, 2016).

The second procedure to be approved, also relevant to water information sharing, was the Procedures for Water Use Monitoring (PWUM) adopted by the MRC Council in November 2003. The objectives of the PWUM are: To provide a comprehensive and adaptive framework and process to support effective implementation of the intra-basin water use monitoring and the monitoring of inter-basin diversions; and to promote better understanding and cooperation among the member States through transparency and confidence in the water use monitoring system⁽ⁱⁱⁱ⁾. The implementation of PDIES and PWUM has been via the MRC-Information System (MRC-IS) and Water Use Monitoring System (MRC-WUMS), which have been under development since 2003. The MRC member states also adopted the Procedures on Water Quality Monitoring (PWQM) in 2011 that addresses potential water pollution and its trans-boundary implication, and that is the basis for collecting and sharing water quality data from 22 stations in the mainstream of the Mekong River each year^(iv).

The Procedures for Notification, Prior Consultation and Agreement (PNPCA) were also adopted in November 2003 by the MRC Council, and relates to Article 5 of the Mekong Agreement. The PNPCA relates to state plans for water utilization that could affect transboundary water flows or quality and details how states will inform each other of their plans and take into account the interests of others, thus constituting an important mechanism for water information sharing. As of May 2020, there have been total of 55 PNPCA projects for water uses submitted through the MRC Secretariat, mostly for tributary hydropower projects(v). There have also been 5 mainstream hydropower projects submitted to the PNPCA since 2010. According to the MRC website (accessed on 14 June 2021)(vi):

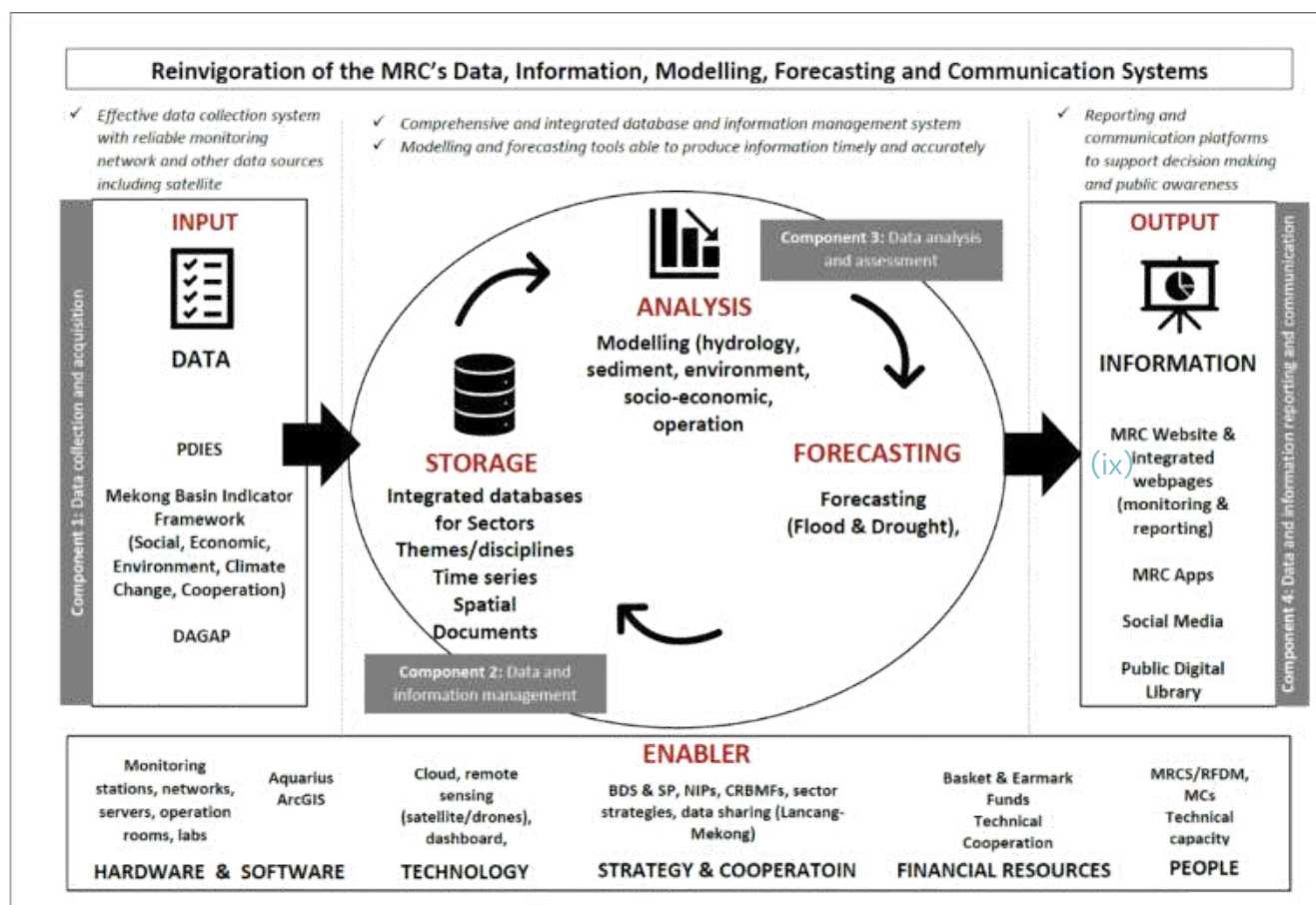
“Implementation of the PNPCA (particularly Prior Consultation) draws much attention and involvement from wide stakeholder, and hence closely tied to the public perception of the MRC. The Xayaburi Prior Consultation process was not yet reached a clearly agreed end point. While the Don Sahong case was agreed by the MRC Council due to different views over the Project to bring the national Government level for further consideration. The Pak Beng and Pak Lay Prior Consultation process have been reached by the MRC Joint Committee on Joint Action Plan (JAP) for the implementation of the Statements on the both hydropower projects. The recent Luang Prabang Prior Consultation process have been ongoing and almost finalized the six-month Prior Consultation process.”

Also relevant to water data sharing are the Procedures for Maintenance of Flows on the

Mainstream (PMFM), adopted in June 2006, that provide a framework for maintaining minimum or maximum levels of river flow in the Mekong mainstream and reverse flow of Cambodia’s Tonle Sap River. The PMFM, which relates to Article 6 of the Mekong Agreement, defines technical criteria to assess adequate levels of water flow to safeguard these seasonal mainstream river flows in the context of water diversions, storage releases from reservoirs, and other actions. The PMFM guides the publication of daily water flows during the wet and dry seasons at hydrological stations along the mainstream(vii), and is part of the MRC’s broader flood and drought monitoring system as well as investigation arrangements when flows cross critical thresholds.

Overall, water data and information sharing are at the center of the MRC’s activities, and prerequisite to the implementation of the Mekong Agreement and for improved evidence-based decision-making. The timeliness of data is also emphasized for forecasting information in critical or emergency situations. In recent years, the MRC has significantly strengthened its capacity for water data management including the upgrading, operation and maintenance of supporting monitoring and communications infrastructure such as the Mekong-HYCOS hydrometeorological network; and the near real-time monitoring, and flood and drought forecasting websites(viii). A new design concept for the ‘Reinvigoration of MRC Data, Information, Modelling, Forecasting and Communication Systems’ was announced in 2019 (Figure 1). It reflects four components: Data and information collection and acquisition; Data and information management; Data and information use; and Data and information presentation. Also in 2019, the MRC’s Regional Flood Centre launched in 2006 was renamed the Regional Flood and Drought Management Centre (RFDMC) reflecting its new broader mandate.

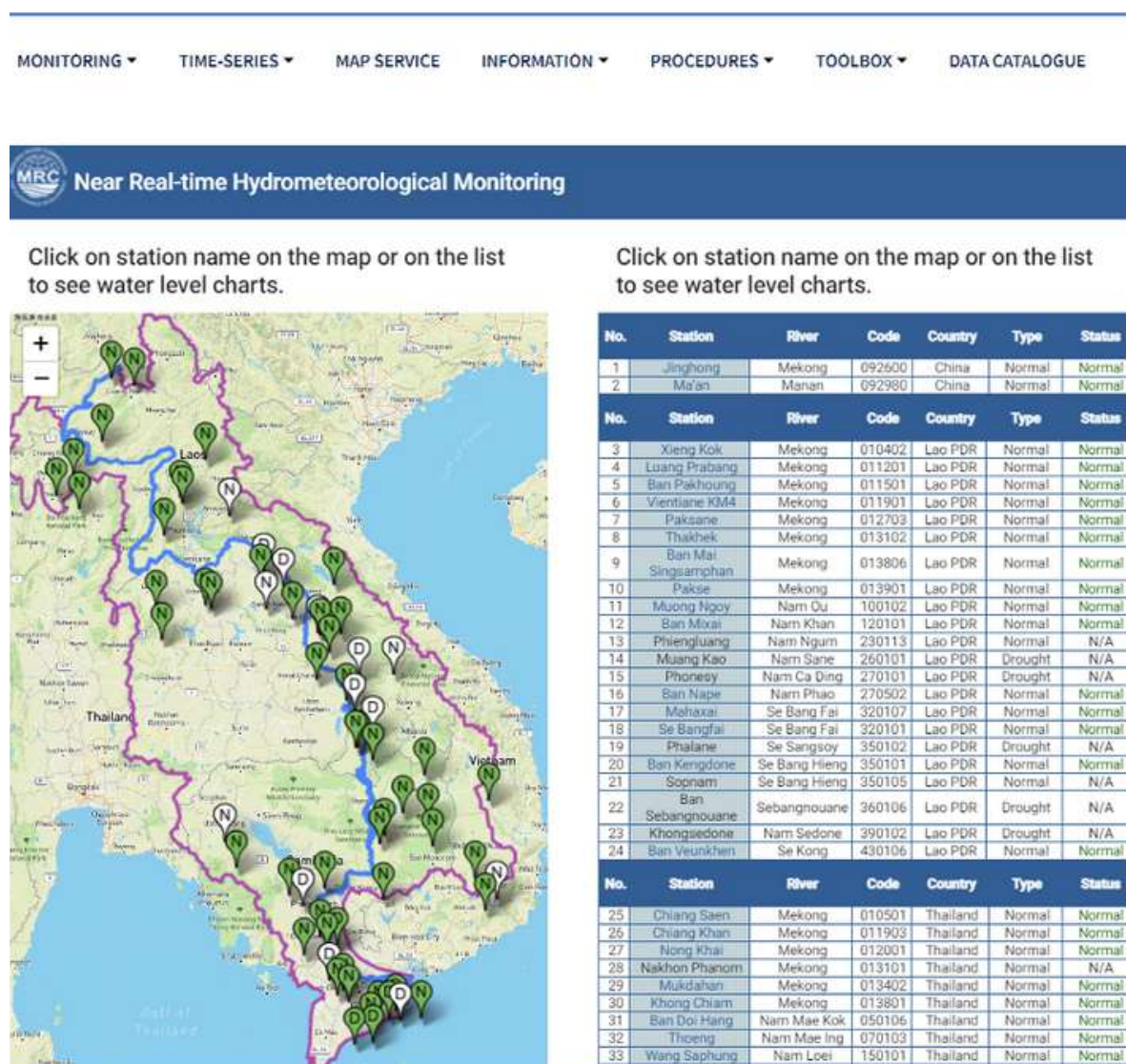
Figure 1: 'Reinvigoration of MRC Data, Information, Modelling, Forecasting and Communication Systems'



As outlined in more detail in section 4.4 below, water data and analysis is shared with the public via the MRC's website www.mrcmekong.org as well as on specialized pages, namely the <https://portal.mrcmekong.org> for river monitoring, which was revamped in November 2020, and www.mekonginfo.org that publishes MRC reports, news and other materials of interest. The MRC's data portal includes "near real time hydrometeorological monitoring" (figure 2). There are also dedicated webpages for flood forecasting (<http://ffw.mrcmekong.org/>) and drought forecasting (<http://droughtforecast.mrcmekong.org/maps>). Other properties monitored and currently under further development are: discharge and sediment; environmental health; water quality; and fisheries. In August 2020, the MRC also announced an innovative collaboration with Facebook to facilitate wider communication with the public to provide early flood alert and drought monitoring information(x).



Figure 2: Screen shot of “Near Real Time Hydrometeorological Monitoring” on portal.mrcmekong.org



Despite these extensive monitoring systems, the impacts and effectiveness of mitigation measures of individual hydropower projects have not been monitored in real time, and the MRC does not have complete access to the operational data of all hydropower projects even in the lower basin. However, a new MRC project was announced in 2019 and launched in February 2020 titled “Joint Environment Monitoring of Mekong Mainstream Hydropower Projects” (JEM) with a focus on the Xayaburi and Don Sahong dams on the Mekong River’s mainstream for 2020 and 2021. According to the MRC: “The overall objective of the JEM is to systematically collect, generate and share reliable and scientific data and information through a standardized basin wide joint environmental monitoring program on site-specific issues that have cross-national implications.”^(xi) Analytical reports will be made publicly available. These studies could help understand unusual river changes observed since November 2019 when the Mekong River turned aqua-marine blue in areas of Laos and Thailand where usually it is a muddy brown. The MRC has already found that this change is due to the drop in sediment load and subsequent algae growth due to low river flows, but the role of hydropower project operation has not been clarified (MRC, 2019a).

Water data sharing between China and the MRC

China has been a Dialogue Partner of the MRC since 1996. According to the MRC's website on this partnership: "From the MRC's perspective, fostering close cooperation with upstream countries is essential to optimally benefit from the increased flow regulation by the storage dams constructed on the Upper Mekong and minimise the risks associated with these projects."^(xii) In addition to joining annual meetings^(xiii), China has shared water data with the lower Mekong States via the MRC since the signing of an agreement on 1 April 2002 which outlines how it would provide water level and rainfall data, free of charge, from two monitoring stations (Jinghong and Ma'an) on the Lancang River during the flood season once per 24-hour period between 15 June and 15 October (MRC, 2002). At the time, it was announced that in return the MRC would provide assistance to the Chinese government to upgrade the two monitoring stations transmitting the data and provide training for the station staff. Technical discussions also explored if it was possible to provide dry season readings and measurements of cross-sections of the riverbed (MRC, 2002).

This agreement had been renewed multiple times in 2008, 2013, and 2019, progressively expanding on its scope. In 2013, the period of reporting extended from 1 June to 31 October and frequency was increased to twice in a 24-hour period. In 2019 the agreement was renewed, and China indicated that it would notify of abnormal rise and fall in water level/discharge that may cause changes downstream (MRC, 2019c). China had also on occasion shared dry season data at times of low flow emergencies, although released data at these times was not complete enough to conclusively determine the role that upstream dams may have played.

Regarding notification on emergency water releases or reductions from operation of the Lancang hydropower cascade, the MRC receives announcements from China's Ministry of Water Resources and publishes them on its website among other channels via the National Mekong River Committees. Table 5 lists the announcements since 2019 (up to June 2021).

Table 5: Notifications from China to MRC on water level changes since 2019

Date	Press release title	Details
5 January 2021	Mekong water levels to drop due to power grid maintenance in China ^(xiv)	<p>Water outflow at Jinghong hydropower station to reduce by 1,000 cubic meters per second (m³/s) due to power grid maintenance during 5–24 January 2021, according to a notification received on 5 January 2021.</p> <p>According to MRC's observation, the outflow level started decreasing from 1,410 m³/s on 31 December 2020 to 768 m³/s on 1 January 2021, representing an almost 50% drop. But the flow rose slightly to 786 m³/s over January 1–4.</p>

30 December 2019	Mekong water levels to drop due to dam equipment testing in China (xv)	The water outflows at the Jinghong hydropower station in China will be reduced by more than 50% due to dam equipment testing from 1 – 4 January 2020. “equipment of the power station” will result in water outflow decrease from the dam from 1,200 – 1,400 cubic meters per second (m ³ /s) to between 800 – 1,000m ³ /s from January 1–3. The amount of water flow will be further reduced to its lowest point of 504–800m ³ /s on January 4 before it is restored to its original volumes.
------------------------	--	---

5 August 2019	Water flow from China’s Jinghong dam to decrease (xvi)	The outflow of water from the Jinghong hydropower station in China’s Yunnan province will decrease by about 25–45 percent over five days decreasing from 1,100 cubic meters per second (m ³ /s) to about 600–800m ³ /s from August 11 – 15 before it will be gradually returned to the original level. The decrease is made for the “maintenance for the transmission lines of the power grid.”
------------------	--	---

3 July 2019	Water flow from China’s Jinghong station to fluctuate, but no major impact is expected (xvii)	The outflow of water from the Jinghong hydropower station in China’s Yunnan province will be fluctuating from 5 – 19 July 2019, the amount of water flowing out from the Jinghong station will start decreasing by about half from 1,050 – 1,250 cubic meters per second (m ³ /s) to 504 – 600 m ³ /s. For over a seven-day period between 10 and 16 July, the amount of water flow will be varying between 504 m ³ /s and 800 m ³ /s. The water flow will gradually be increased on 17 July and returned to normal (1,050 – 1,250 m ³ /s) by 19 July. The water flow arrangements are made to accommodate the “grid maintenance” at the Jinghong hydropower station.
-------------	---	--

8 April 2019	Water flow in Jinghong of China to decrease, but without significant impact downstream (xviii)	The outflow of water at the Jinghong hydropower station in China will gradually decrease by almost half over a seven-day period in April from 11 April 2019 at 00:00 am, the outflow of water at the Jinghong hydropower station will start decreasing from 2,000 – 3,000 cubic meters per second (m ³ /s) to 1,500 – 1,600 m ³ /s. This amount of water flow will be gradually increased to the original amount of 2,000 – 3,000 m ³ /s on 17 April from 00:00 am. The decrease of water will be made to accommodate “the traditional activities
-----------------	--	--

on the Lancang (Mekong) River during the Water Splashing Festival of the Dai ethnic group,” the notification said.

On 22 October 2020, an important development in water data sharing was announced when an agreement was signed between the MRC Secretariat and the Ministry of Water Resources of China for China to provide year-round rainfall and river level data to the MRC from its two monitoring stations twice per day(xix). The agreement also affirmed China’s commitment to “share urgent information on any unusual rise or fall in water levels and discharges, as well as other relevant information on factors that might lead to sudden flooding in the lower reaches of the basin” (MRC, 2020a). While this is part of ongoing incremental increases in cooperation and data sharing over the years, this announcement occurred in the context of serious drought across the region and low river flows which some had linked to China’s upstream hydropower development (see Section 5).



kjorgen / "View over Mekong River from Luang Prabang" via Getty Images

The recent intensification of data sharing and cooperation also reflects the evolving relationship between the MRC Secretariat and the Lancang–Mekong Water Resources Cooperation Centre (LMWRCC) (MRC, 2019d). In December 2019, a first MoU was signed between the two organizations that proposes collaboration on data and information exchange, basin-wide monitoring, and joint assessment on Mekong water and related resources. As an initial step, both sides agreed to conduct a joint research on the 2019 drought and low flow situation in the Mekong River basin, aiming to identify the causes and impacts of drought and low flow condition in 2019(xx). According to the MRC’s press release at the time, “the study will also provide recommended measures and actions related to data and information sharing and improvement among all the riparian countries, develop a clear communication protocol, and enhance coordinated operations of the reservoirs in both China and the Mekong countries for a more effective response to the current and future issues of drought and water flow” (MRC, 2019d). Such a study, once finalized, would be a significant achievement in collaborative research and open data sharing if made publicly available(xxi). The MRC Secretariat also currently holds observer status at the annual meetings of the Lancang Mekong Cooperation’s Joint Working Group on Water Resources, which is also an opportunity for information sharing between the two organizations. However, there is much debate over the extent to which the MRC and LMWRCC are in tension over their shared transboundary water governance mandates (Haffner, 2020, Biba, 2018, Williams, 2020).

An earlier joint research study between the MRC, LMWRCC, China Institute of Water Resources and Hydropower Research (CIWRHR), and the International Water Management Institute (IWMI) focused on the drought and emergency water releases from the cascade dams on the Lancang River to increase flow in the Mekong River downstream (MRC et al., 2019)(xxii). During the study, the parties agreed to exchange and share hydrological data, including water level and discharge on the Lancang and Mekong mainstems. The report was published in October 2019 titled "Hydrological Impacts of the Lancang Hydropower Cascade on Downstream Extreme Events." The key findings of the study were: "Both the Chiang Saen and Luang Prabang stations have experienced significant hydrological change from 2009–2016 compared to 1998–2008; There has been increased streamflows during the dry seasons of 2012/2013 and 2015/2016 which can be attributed mainly to hydropower influences; and the flash flood of December 2013 is attributed to rainfall happened in downstream sections of Lancang River, not the regulation of Lancang hydropower cascade." It recommended:

- key findings should be disseminated widely to stakeholders and the public, including via the MRC Regional Stakeholder Forum as well as communication channels of China, LMWRCC and IWMI;
- the MRC Joint Committee and the LMC Joint Working Group on Water Resources should convene a special joint meeting as needed on situations of unusual/extreme flood and/or drought and how dam cascade operation could address the issue; and
- there should be further joint studies to increase the knowledge base, enhance data and information sharing, improve or establish better coordination mechanisms and formulate specific basin-wide strategies and policies.

Water data sharing via the Lancang Mekong Cooperation framework

The LMC, established by China in 2016, seeks greater engagement between China and the countries of Southeast Asia Cambodia, Laos, Myanmar, Thailand and Vietnam with whom it shares the Lancang–Mekong River. It does so through a broad, project-focused approach encompassing three pillars (1. political and security issues, 2. social cultural and people-to-people exchange, and 3. economic and social development) and five priority areas including water resources (1. agriculture and poverty reduction, 2. water resources, 3. production capacity, 4. cross-border economic cooperation, and 5. connectivity). Although not explicitly stated, China plays a leading role in the LMC, offering significant funding and policy direction (Middleton and Devlaeminck, 2020). According to media reports, since the launch of the LMC, "China has partnered with other five countries in at least 20 water-related projects, involving river planning, water resources information sharing, water conservancy standards and regulations, and flood and drought disaster prevention" (Global Times, 2020). The Lao Government, in a statement issued for the Third LMC Summit, also stated "Our cooperation has witnessed a series of pragmatic outcomes: Laos Water Resources Data Center and more than 50 modern hydrological demonstration stations aided by China have been put into operation, demonstration projects for dam safety and safe drinking water launched consecutively."(xxiii)

Data and information sharing also plays a strong role in LMC cooperation, which was first identified by member States in the Sanya Declaration as part of LMC cooperation to be conducted through a then yet to be established center. This center, LMWRCC, was established in Beijing in 2017. Data and information sharing has been

consistently mentioned in relation to water resources cooperation in LMC documents, with States consistently indicating this is an area marked for greater cooperation. While the purpose of information sharing is not further elaborated upon in these documents, information sharing is often connected to the “sustainable management and utilization” of shared water resources (see Leader’s Meetings, for example) and minimizing negative impact (see 5th Foreign Minister’s Meeting) (Table 6). While these documents contain broad statements regarding information and are considered to be non-binding, member States have pledged to move “towards comprehensive LMC data and information sharing”, likely to include both emergency notifications as well as regular hydrological information sharing. The Vientiane Declaration of the Third Mekong-Lancang Cooperation (MLC) Leaders’ Meeting on 24 August 2020 also commits to “Support establishment of Mekong-Lancang Water Resources Cooperation Information Sharing Platform.”(xxiv)

Table 6: Information Sharing in LMC documents

Date	Title	Mention of Information Sharing
23 March 2015	Sanya Declaration of the 1st LMC Leader’s Meeting	“Enhance cooperation among LMC countries in sustainable water resources management and utilization through activities such as the establishment of a center in China for Lancang-Mekong water resources cooperation to serve as a platform for LMC countries to strengthen cooperation in ... <i>data and information sharing</i> ...” (para. 10)
10 January 2018	Phnom Penh Declaration of the 2nd LMC Leader’s Meeting	“Strengthen cooperation on sustainable management and utilization of water resources through ... <i>sharing of data and information</i> ” (2.5)
10 January 2018	Five –Year Plan of Action on Lancang-Mekong Cooperation (2018-2022)	“carry out joint study on the early setting up of communication line/channel for <i>sharing information in emergency case of flood and drought</i> in Lancang-Mekong River.” (4.7)
3 August 2018	Five-Year Action Plan on Water Resources (2018-2022)	<p>“strengthen comprehensive cooperation in ... <i>data and information sharing</i>” (Background)</p> <p>“Advancing information sharing. Hydrological data during flood season and other information have been shared among us. <i>A mechanism of data and information sharing on floods, droughts and emergency water -related situation is under consideration and discussion.</i>” (Background)</p>

"strengthen international exchange and cooperation in the field of water resources. Further intensify ... *information exchange* ..." (3.2)

"Six member countries will strengthen transboundary river cooperation and *promote information sharing including hydrological data and relevant development information*, with a view of jointly addressing water-related challenges encountered by six member countries under the changing climate."(5.6)

17
December
2019

Joint Statement of
the 1st Ministerial
Meeting of the
Lancang-Mekong
Water Resources
Cooperation

"Since the launching of the LMC, our six countries have been working together to implement the decisions of our leaders and bring forward concrete cooperation in the field of water resources. Major results include... Extensive technical exchanges have been carried out on a wide range of topics, with data and information sharing promoted, including efforts to share hydrological data during the flood season..." (6 & 6.4)

"We will continue to take joint actions to implement the decisions made by our leaders, through policy dialogue, information sharing..." (10)

"We, while fully implementing the *MOU on the Provision of Hydrological Information of the Lancang River in Flood Season by China* to the Other Five Member Countries, will strengthen and expand cooperation on data and information sharing among member countries *towards comprehensive LMC data and information sharing in the field of water resources.*" (12)

20
February
2020

Joint Press
Communiqué of
the 5th LMC
Foreign Minister's
Meetings

"The Ministers of Mekong countries *appreciated China for the direct provision of hydrological information* of the Lancang River in the flood season within the MLC framework, and positive contribution to coping with the severe drought in Mekong-Lancang River Basin. The Ministers agreed to ... *enhance the sharing of hydrological information... with a view to ensuring sustainable use of water resources, and minimizing negative impact on the livelihood and environment along the Mekong-Lancang River.*" (10)

24 August
2020

Vientiane
Declaration of the
3rd LMC Leader's
Meeting

"Welcoming the upgrading of the MLC Water Resources Cooperation, appreciating China's intention to share hydrological information of the Lancang River throughout the year..." (7)

"Further strengthen cooperation on sustainable management and utilization of water resources: ... conducting policy dialogues, sharing of data, information and experiences in the implement of transboundary water resources management... Support establishment of Mekong-Lancang Water Resources Cooperation Information Sharing Platform." (2.6)

8 June
2021

Joint Statement
on Enhancing
Sustainable
Development
Cooperation of
the Lancang-
Mekong Countries

"We highly appreciate the broad consensus on future cooperation reached among the water authorities of the six member countries, including supporting China for convening the Second Lancang-Mekong Water Resources Cooperation Forum and Viet Nam for convening the Second Ministerial Meeting on Lancang-Mekong Water Resources Cooperation, strengthening pragmatic cooperation on flood and drought disaster mitigation, clean drinking water and sanitation services, hydrological information monitoring and alignment of technical standards, fully promoting the building of the Lancang-Mekong Water Resources Cooperation Information Sharing Platform through an appropriate mechanism, and enhancing the capacity of member countries in sustainable water resources development and management." (p. 3)

LMC cooperation on information sharing culminated in the launch of the Lancang-Mekong Water Resources Cooperation Information Sharing Platform in December 2020 (www.lmcwater.org.cn)^(xxv). This online platform provides a publicly accessible portal for hydrological information from two monitoring stations on the Lancang River (Yunjinghong and Manan). This includes information on the water level at these two stations, updated hourly. The platform also publishes various notifications of sudden changes in upstream water levels or activities that may impact downstream riparians. These notifications are often provided a few days in advance. The information sharing platform also seeks to act as a knowledge platform, publishing LMC policy documents, minutes of meetings, information on national policies and regulations, and links to expert opinions and research.

While the future plans of the platform are unclear at this time, it is likely that the information made available will continue to expand. At the 2020 Water Resources Joint Working Group Meeting members indicated that the information sharing platform would have the following

functions and features: a website portal, interactive maps, decision making support systems, a standards system for water information sharing, video conference/consultation system, and increased infrastructure (for example, GIS).

Web-based Water Data Sharing Platforms

Water data and its analysis on the Mekong Lancang River is increasingly available via government managed web-based platforms. As introduced above, the MRC (portal.mrcmekong.org) and the LMC (www.lmcwater.org.cn) both host websites as platforms for water data and information sharing. A third recent high-profile platform, independent of MRC and LMC, is the Mekong Dam Monitor (www.monitor.mekongwater.org), created with the support of the Mekong US Partnership and operated by the Stimson Center and Eyes on Earth.

Table 7 provides an overview of the types of water data and information shared, and governance basis of each platform. At present, the MRC's website is most comprehensive, and is selectively translated into regional languages. The LMC's website has also expanded since its launch and includes analysis, commentary, law and policies, and LMC meeting reports, including of the 2021 Lancang-Mekong Cooperation Week on Water Resources held in Yunnan from April 26 to 29, 2021. The Mekong Dam Monitor mainly focuses primarily on the changing water levels in mainstream and tributary (<200 MW) hydropower dam reservoirs.

Table 7: Comparison of Web-based Water Data Sharing Platforms

	Mekong River Commission	Lancang Mekong Cooperation	Mekong Dam Monitor
<i>Type of Data and Information Shared</i>			
Source of data	61 stations, updated every 15 minutes, except the 2 China stations which are publish hourly data updated twice per day	2 stations, updated once a day with hourly data	26 'virtual gauges' located at dam sites, updated near real time
Stations	<ul style="list-style-type: none"> China 2 stations (1 mainstem; 1 tributary) Lao PDR 18 stations (4 mainstem; 12 tributary) Thailand 11 stations (6 mainstem; 5 tributary) Cambodia 15 stations (2 mainstem; 12 tributary) Viet Nam 15 stations (3 mainstem; 12 tributary) 	<ul style="list-style-type: none"> China 2 stations (1 mainstem; 1 tributary) 	<ul style="list-style-type: none"> China 11 virtual gauges (11 mainstem) Lao PDR 10 virtual gauges (2 mainstem; 8 tributary) Viet Nam 4 virtual gauges (4 tributary) Cambodia 1 virtual gauges (1 tributary)

Meteorological Data	Rainfall	Rainfall	n/a
River Data	Water Level	Water Level	Water Level Citizen reporting (forthcoming)
Analyzed water data	<ul style="list-style-type: none"> Flood forecasting and warning Drought monitoring Discharge and sediment monitoring Environmental health monitoring Water quality monitoring Fisheries monitoring Climate change and adaptation 	Previous analytical reports	<ul style="list-style-type: none"> Wetness, Temperature and Precipitation Anomalies Natural River Flows Model Lancang Cascade Basin-wide Dams and Connectivity
Knowledge Bank	<ul style="list-style-type: none"> A separate platform called “Mekong Info” which includes various reports from other organisations related to Mekong, divided into sections based on topics, type of documents Procedures for Notification, Prior Consultation, and Agreement (PNPCA) database Various laws and regulations in each MRC members related to hydropower development Land cover information 	<ul style="list-style-type: none"> Compilation of research from LMC and other organisations on issues related to Mekong A section called ‘water stories’: compilation of stories/article related to Mekong river; Various laws and regulations in each Mekong Countries related to water management LMC meeting and event reports 	<ul style="list-style-type: none"> Various reports from the Mekong-US Partnership activities
Governance			
Policy basis	<ul style="list-style-type: none"> Established based on the 1995 Mekong Agreement and Procedural Rules 	<ul style="list-style-type: none"> The LMC was established based on the Sanya Declaration of the 	<ul style="list-style-type: none"> The Mekong Dam Monitor is hosted on mekongwater.org

- Data sharing regulated under the Procedures for Data and Information Exchange and Sharing (PDIES) (01 November 2001), and the portal is established based on the procedure
- Series of agreements with China on data sharing since 2002

First Lancang–Mekong Cooperation (LMC) Leaders’ Meeting. Subsequent joint statements mention information and data sharing as an area of cooperation, for example in the Vientiane Declaration of the Third Lancang–Mekong Cooperation (LMC) Leaders’ Meeting in point 2.6 (August 2020).

- Paragraph 8 of the Mekong–U.S. Partnership Joint Ministerial Statement (15 Sept 2020) paragraph 8 addresses the importance of strengthening the MRC and the implementation of PDIES, and acknowledges mekongwater.org under the Mekong Water Data Initiative and the Sustainable Infrastructure Partnership

Funding source

- Contributions from MRC Member Countries;
- MRC’s Development Partners including: Asian Development Bank (ADB); Association of Southeast Asian Nations (ASEAN); International Union for the Conservation of Nature (IUCN); United Nations Development Programme (UNDP); United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP); World Wildlife Fund (WWF); World Bank (WB); and bilateral funding, including from Australia, Japan, US, France, and Germany

- Not stated on website, but known to be funded by China

- Mekong–US Partnership (MUSP);
- the Chino Cienega Foundation;
- Other individual donors

Several other websites are also available that compile and present water data and information, which are more briefly summarized below:

- MekongWater.org: In addition to hosting the 'Mekong Dam Monitor' detailed in Table 7, this website hosts more than 50 tools from 35+ partners (including the United States Geological Survey, the National Aeronautics and Space Administration, and the National Oceanic and Atmospheric Administration) on river basin mapping and hydrology, weather forecasting, open-source data analysis tools, ecosystem, and citizen science. It includes Mekong Hydroshare, which is a community database where Mekong users can store and share their data securely and for free, and is available to registered users. The website is part of the Mekong Water Data Initiative (MWDI), which is a program of the Sustainable Infrastructure Partnership that is in part supported by MUSP and managed by the University of Virginia. It is free to access, available to the public and the public can also submit their resources.
- Opendevelopmentmekong.net: This website is part of the Open Development Initiative and a project of East-West Management Institute. Its stated aim is to present data impartially, using open data standards alongside analysis through visualisations, briefings, maps, and other data products to increase transparency and accessibility. It is also establishing a network of local data sharing partnerships and building capacity for data and digital literacy across the region. Data on water resources include: compiled news, announcements and events; and other knowledge/information resources.
- Mekong Infrastructure Tracker^(xxvi): This website is hosted by the Stimson Center, and supported by the USAID Mekong Safeguards activity, which is implemented by The Asia Foundation, to track, monitor, and quantify the development of energy, transportation, and water infrastructure assets and the social, economic, and ecological changes that they bring to Southeast Asia. The website includes tools to analyze details of energy, transportation, and water infrastructure projects, including possible impacts.

Overall, these platforms make available a range of water data and information to the interested public, although as discussed in section 6 below not all of the information is in a form that is understandable or actionable by riparian communities or civil society. Much of the information is available in English and is relatively technical in character, which is more suited to government and practitioner experts and researchers, although some information is conveyed in regional languages or in graphic form, for example of water levels and changes on the MRC website which is intended to facilitate a wider understanding.



Drought, low flows and water data politics (2019-2020)

The low flows in the Mekong River during 2019 and 2020 intensified attention on transboundary water governance and the extent to which water data availability informs it. The region has faced a drought, further amplified by the El Niño weather pattern. The low flows placed ecosystems, fishing and farming livelihoods, wider food security, and even drinking water supply at risk. Questions have been raised regarding to what extent low flows are the result of drought due to a lack of rainfall, and what is the influence of storage of water in reservoirs? Attention has been directed towards mainstream hydropower projects in China and Laos, in part due to the incomplete data and information in the public domain on their operation and storage. The debates have also intensified scrutiny of transboundary water governance institutions, including the MRC and LMC, and how cooperation and competition occur simultaneously between states (Middleton and Devlaeminck, 2020).

During this period of low flow, operation of the Jinghong Dam – the lowest in China’s Lancang cascade – has on occasion led to reductions in river water flow and abnormal fluctuations. Flow reductions were stated by China to be necessary due to maintenance at the project. For example, the MRC reported that water levels dropped on the river by up to one meter in Thailand and Laos from 27 December 2019 to 4 January 2020 (MRC, 2020e). As agreed by Memorandum of Understanding, China had sent notification via the MRC on 31 December, which stated water outflows would drop by 50 percent affecting river water levels in Thailand, Lao PDR and Cambodia (MRC, 2019b). However, at present disseminating information amongst riparian communities for their preparedness remains a challenge (see section 6).

The public debate on the Mekong–Lancang River’s low flows intensified with the publication of a report in April 2020 by the research consultancy Eyes on the Earth that detailed a model of the natural (pre-dam) flow of the Lancang River to then predict the impact of the dams onto Northern Thailand downstream (Basist and Williams, 2020). Given the incomplete availability of water data in the public domain



Nhan Le / "Drought Season in Mekong Delta" via Getty Images



on the Lancang River in China, the report's statistical model used satellite data to create a 'wetness index' to estimate the amount of water in the catchment, and then related this to monthly measurements of water levels at the gauging station in Chiang Saen in Northern Thailand. This reflects a growing interest in general in the use of satellite data where formal data sharing arrangements are not in place (Leb, 2019). Overall, the study showed how since dams in the Lancang cascade began to be commissioned in the early 1990s there had been a decrease in wet season river levels and an increase in dry season levels, and more irregular and rapid fluctuations in water levels in both wet and dry seasons. These changes became especially pronounced since 2012 when the 5,850 MW Nouzhadu dam began reservoir filling, given that its reservoir is considerably larger than the preceding four projects combined. While these conclusions have also been reached by previous scientific studies, such as Räsänen et al (2017), the Eyes on Earth report, gained significant media attention in regional and international outlets (e.g. New York Times, 2020), as it was drawn upon by several civil society groups as well as representatives of the US Government to claim that it provided evidenced that China was responsible for the severity of the 2019–2020 low flows and had “turned off the tap”^(xxvii) or was “hoarding” water (Johnson and Wongcha-um, 2020). These statements also led in turn to responses from China's diplomats (e.g. Hu and Lin, 2020) and researchers (e.g. Tian, Liu and Lu, 2020).

Such significant claims led to careful scrutiny of the report including by the MRC (2020d), AMPERES (Ketelsen et al., 2020b), and academics (Kallio and Fallon, 2020). While discussion on the causes of low flows on the Mekong-Lancang River were broadly welcomed, these reviews flagged a number of limitations of the report including that: it provides results in terms of water level, but this cannot be considered equivalent to water volumes; it did not demonstrate that

China could store all of the water in the rainy season, hence being capable of fully withholding the river's flow causing drought in the downstream; and that it would have been better if the study had been peer reviewed before publication. Moreover, researchers at AMPERES concluded that the representation of the report in the public debate often went beyond its actual findings (Ketelsen et al., 2020a).

In July 2020, a group of researchers from Centre for International Transboundary Water and Eco-Security of Tsinghua University and the China Institute of Water Resources and Hydropower Research added to the debate with a study which concluded that: the Lower Mekong River Basin (LMRB) is experiencing high frequency of drought, and the proportion of drought occurring in the dry season is significantly higher than that in the wet season; The 2019 drought is among the most severe droughts in the past century; and the regulation of reservoirs in the Lancang-Mekong River Basin could play an active role in dealing with droughts in the Basin. It recommended: Integrated structural and non-structural measures to alleviate drought; Joint operation of mainstream and tributary reservoirs for flood prevention and drought relief; and Joint research on the whole-basin flood and drought forecasting system. A commentary on the study found that it too required further clarification and that the study's conclusions on the benefits of the dam cascade in China to alleviate downstream drought conditions were potentially misleading (Kallio et al., 2020).

The 2019 and 2020 low flows occurred at a time of intensified geopolitics between the United State and China in Southeast Asia and globally (Kishimoto, 2020), leading to a hydropoliticization of the drought(xxviii). The politicization of the research that occurred – where the limitations of studies are downplayed and the results transformed into

simplified narratives –undermined the credibility of scientific evidence that could otherwise be the basis for informing processes of transboundary water governance and decision making. Overall, the above studies on the Mekong-Lancang River's low flows and the impacts of China's dam cascade on downstream countries were based on incomplete water data due to a lack of access to already existing data at the time. The announcement of all-year round data sharing between China and the MRC in October 2020, and the anticipated publication of a joint LMC-MRC study on the 2019 drought and low flow situation in the Mekong River basin are important steps towards addressing some of the data uncertainties and to increase transparency and inter-institutional cooperation.

However, in terms of intergovernmental water data sharing there is more to be done. To make the status of the river in China more transparent, the number of monitoring stations could be expanded to cover all eleven hydropower dams now in operation and to include data on upstream and downstream water levels and flows for each dam's reservoir as well as each dam's operation schedule. It could also include tributary river water data, which is already extensively collected, while sharing historical data sets could help establish previous conditions in the basin. There are also important data gaps to be addressed in the lower basin, including for the operation of tributary projects that influence flood and drought conditions locally and cumulatively throughout the basin. Furthermore, data on the impact of mitigation measures at the recently completed Xayaburi Dam on the Mekong River's mainstream in Northern Laos is still not in the public domain, although as noted above, the MRC has initiated since February 2020 the JEM project to study these impacts.

Empirical case studies on community-level access to water data in Thailand

In this section, we present empirical research on water data sharing in North and Northeast Thailand. The field-based research examined: How do livelihoods in riparian communities relate to water resources and how have they been affected by changing water levels?; What is the role of government line agencies and the local authorities in sharing information about changing water levels?; How do community members receive information about changes in water levels?; and How do community members share their own experience and knowledge about changing water levels with local authorities and line agencies? We first briefly summarize information on water levels available via two online platforms hosted by Thai government agencies.

Water data on Thai government websites

In Thailand, there are two Government line agencies primarily responsible for providing data and information about water level on the Mekong River via websites that they maintain: The Office of National Water Resources (ONWR) via the Thai National Mekong Committee Information System (TNMC-IS); and the Bureau of Research, Development and Hydrology in the Department of Water Resources of the Ministry of Natural Resources and Environment. For both websites, infographic updates are provided on working days (Monday–Friday)(xxix).

The TNMC-IS provides an infographic using color coding that indicates the current water level(xxx) and the expected changes in water level over the coming 1–7 days(xxxi). Information on water levels are also shared via the ONWR Facebook page. Data come from various sources including the Department of Water Resources, the Royal Irrigation Department, the Hydro-Informatics Institute, and the Mekong River Commission Secretariat. Some sections of the TNMC-IS website link directly to the



MRC Secretariat website, and are in English rather than Thai language. Information specifically on the releases of water from the upstream Lancang dam cascade are not posted publicly to the ONWR website. ONWR advised that water levels at the lower two dams in the Lancang cascade are available via the MRC website^(xxxii), and information on water releases are available from the LMC Water website^(xxxiii). Both of these websites, however, are presented in English.

The Bureau of Research, Development and Hydrology shares data on water levels at six stations along the Mekong River mainstream in Thailand, as well as at the Jinghong Dam in Yunnan Province, China and at Luang Prabang in Laos^(xxxiv). The data can also be downloaded as a .pdf, which includes information on: the level of water, visually shown against the cross-section of the river for Thailand's monitoring stations; a graphic with information on the water levels over the previous 7 days; and information on the water flow at each station. While it does not directly calculate anticipated water levels for the coming 7 days, to an extent the reader can calculate it using the data provided with the water level at the Jinghong Dam station. Similar to ONWR's website, information on water releases from the Lancang Dams are not posted directly. The data on the Bureau of Research, Development and Hydrology is from the ONWR and the MRC Secretariat.

Northern Thailand^(xxxv)


Introduction

Chiang Rai province is the northern most province in Thailand and is located on the upper reach of the Lower Mekong Basin. The research for this section focused on Chiang Saen and Chiang Khong districts which are both located on the Mekong River. Chiang Saen has a population of about 50,000 and its economy relies on tourism, cross-border casino (King Roman), subsistence fishing and farming (rice, corn and vegetables). Chiang Khong is located further downstream with a

population of about 63,000. It is strategically important as a gateway crossing point to Lao PDR and Yunnan Province through R3B route. The region is constrained mostly by mountainous areas along with valleys that are suitable for subsistence fishery and agricultural practices. The Mekong River forms a 97 km border line between Chiang Saen, Chiang Khong and Wiang Kaen district, Chiang Rai Province in Thailand and Hoay Xai, district, Bokeow Province in Lao PDR.

It is reported that in the dry season more than 60% of the Mekong River water flow at Chiang Saen comes from China and the remaining 30–40% from Mekong tributaries (Lu et al., 2014). Observed water level at Chiang Saen Water station on the daily basis showed significant reductions of water level during the wet season between 2002–2020. According to the MRC's 2018 State of the Basin report, the river flow data for Chiang Saen showed that the average of the total annual flow volume was reduced by 13% with the observed value of flood season flows generally reduced by 35% and the dry season flow increased by 34 % in comparison with the previous decades (MRC, 2019e). All interviewees agreed that they noticed unusual changes to the Mekong River water levels starting about a decade ago, and that now the river is occasionally clear instead of its normal muddy brown color.

In this area, communities rely on and are affected by the changing river conditions in various ways, depending on their occupation. The river transportation sector usually benefits from the more stable water level. One Government officer commented that the water level difference between the rainy season and the dry season used to be 10 meters but was now reduced to about 7 meters, which improved navigation and benefited trading between Thailand and China. The representative from Chiang Saen Port said changes in water levels can impact port operations because once or twice per



year the water level is too low for boat docking; when this happened, authorities in China would request China's dams to release water. A cruise boat owner commented that that water level changes do not affect their boats, which are designed for shallow draught but that their business was affected by COVID-19 and the consequent closure of the border with China. However, the research team met one boat owner whose cruise boat was sunk due to being tightly tied to a mooring post as water rose rapidly in August 2020.

Community members who practice riverbank agricultural, or who collect aquatic resources such as river weeds (Kai) or who practice wild-capture fishing are negatively affected. Some interviewees reported that fishers' 2020 fish catch was up to 50-70% less than previous years. One community leader

said that modified flow has greatly impacted communities as they cannot adapt or could not find a supplement food or income for the farming. In their view, the reduced wet season flow had significantly impacted the seasonal flooded wetlands along the river, well as the reverse tributary flows on the Ruak, Kok, and Ing Rivers that connect to the mainstream and that affected wetlands such as Boon Ruaeng and Wiang Non Lom there were once important fish spawning ground. Without the wetlands, fish catch is greatly reduced and thus there are less supplemental income for the community. These high flows also used to bring sediment and nutrients in the wet season that supported community farming in the dry season. Community leaders report that the reduction of wet season flow caused the cancellation of boat racing in the Sob Kok area, the loss of local knowledge on fishery, and that other cultural ceremonies are also impacted. Many local people have abandoned their traditional practices and migrated to work as a low-paid labor in the city. Interviewees also pointed that a recent riverbank stabilization project was expensive and funded by tax, but was required due to the changing river levels.

Other users of water, including for water supply and sanitation, and local water-related business such as river-side restaurants and guest houses/hotels are also struggling to adjust to the new situation. Meanwhile, a government officer also mentioned the increasing numbers of people illegally crossing the border when the water is low for the past two year (2019 and 2020), and that amphetamine smuggling is increasing seemingly as a result.



Apisom Intralawan / "Riverbank garden in the Golden Triangle area that has moved from the riverfront to near the road away from the river"

Water data sharing between government and communities

Regarding local water data sharing, in the recent past it was the responsibility of various line agencies namely, the Water Resource Regional Office 1, the Department of Disaster Prevention and Mitigation, and the Marine Department; as well as the Provincial Governor and District Chief. However, there is not a clear role for local authorities that are at the administrative level closest to communities.

According to an officer from the DWR, they monitor the river's water level from three gauges in the area, and the data is automatically displayed on a digital screen on a daily basis at the traffic junction in Chiang Saen town for public access^(xxxvii). The data is also sent to the other government department via LINE message including the Marine Department who is responsible for navigation. In case of an abrupt increase or decrease of water level, there will be an official public announcement or the safety of boat navigation, and to warn downstream communities. The provincial government

representative said that they also issue an official warning and distributed it the District Chiefs. However, interviewees agreed that there are many organizations involved, the communication channel is unclear, and warnings are not usually announced well in advance^(xxxviii). Since January 2021, responsibility for the detailing the hydrological condition, including in relation to upstream dam operation, has shifted to Office of National Water Resource, but according to interviewees a new communication channel had not been clearly established in the local area yet. Among the interviewees, there was little awareness of the water data available on the LMC and MRC websites^(xxxix), or the information was not considered useful to their needs. A local business owner said that the most effective way to get water data is from Chinese boats travelling from Jinghong to Chiang Saen, as they know the hydrological conditions upstream.

Local community representatives interviewed confirmed that they usually received river information via from public

announcements by the Marine Department via a loud speaker if there is abrupt change of the water level that could jeopardize the local navigation in the area. They said, however, that they do not have enough time to mitigate the impacts. Moreover, among non-government interviewees, there was a perception that the current water data is not that useful. They needed predicted water levels more in advance to allow them to better prepare and adapt, and they want to participate in water level management.

Community leaders usually share their own experience about the changing water levels and its impacts among themselves and occasionally with local authorities, who are also seen as community leaders. Civil society help distribute information mostly about the current water level through Facebook and LINE, and there have been recent TV news reports regarding to the unnatural flow and blue color of the Mekong River. However, media and civil society only have a limited role in terms of providing early warning on water releases. Community leaders largely agree that the issue of water management can only be resolved at the country level by the central government as they are the party which has real authority to discuss with neighboring countries^(xli).

Northeastern Thailand ^(xli)

Introduction

The Northeast region of Thailand – locally called the Isan region – borders to Laos and Cambodia. The main river systems in the Northeast are the Mun, the Chi (the main tributary of the Mun) and the Nam Songkhram. All of them are the major tributaries of the Mekong River mainstream. A number of hydropower and large-scale irrigation projects were initiated in Northeast Thailand to stimulate economic development since the mid-1980s until the present.

Local people living along the Mekong River and its tributaries in the Northeast region are

primarily rural and the livelihood sources of the majority of the people are related to different kinds of use of natural resources. Overall, agriculture (particularly rice cultivation), together with fishing and related activities like riverbank vegetable gardens form the most important sources of income as well as for local consumption; there are a significant number of fulltime fishers across the region. Aquatic resources, frequently collected freely from communally owned areas, are an important component of food security and income. Villagers catch fish from Mekong mainstream and various river channels, its tributaries and are mainly using key commercialized fishing gear, different size of nets. Apart from fish capture, other living aquatic resources such as frogs, shellfish and insects are harvested from the riverbanks and wetlands for food and sale. As such, the health of the river ecosystems feeds directly back to the welfare of Isan people.

Over the past several years, the Mekong River has changed significantly in the two communities visited in Ubon Ratchathani Province and Nong Khai Province, which includes prolonged periods of low flow, water that is a clear, of a blue hue, and lacking sediment, and unpredictable rise and falls of the water levels. It is widely perceived that these changes are due to the operation of the Xayaburi Dam upstream on the Mekong River's mainstream in Northern Laos, and beyond this project due to the operation of hydropower dams on the mainstream in China. These changes have affected the local availability of flow-dependent resources, particularly fish and other aquatic animals (OAAs), that impact the most vulnerable group as they are highly dependent on flow-sustain resources all year around. Moreover, there has been the rapid growth of green algae in the clear water, which clogs up fishing nets and creates extra time-consuming work to clean them before fishing again. Boats also become stranded on rapids or riverbanks during the quick arrival of low

flows that require extra time and labor to remove them back into the river. These changes, which had especially affected vulnerable groups who are most dependent on Mekong River aquatic resources are of great concern to community members, local authorities and civil society groups interviewed.



Kanokwan Manorom / "Fisher on the Mekong River in Northeast Thailand"

Water data sharing between government and communities

Government agencies, such as the RID Office in Ubon Ratchathani town, do have access to real-time water level and rainfall data on the Mekong River's mainstream and tributaries, as well as data on reservoir levels in Thailand. The RID Office in Ubon Ratchathani town also has ready access to hydrometeorology water data from the Office of National Water Resources (ONWR) that includes from stations in China, Laos and Thailand more widely.

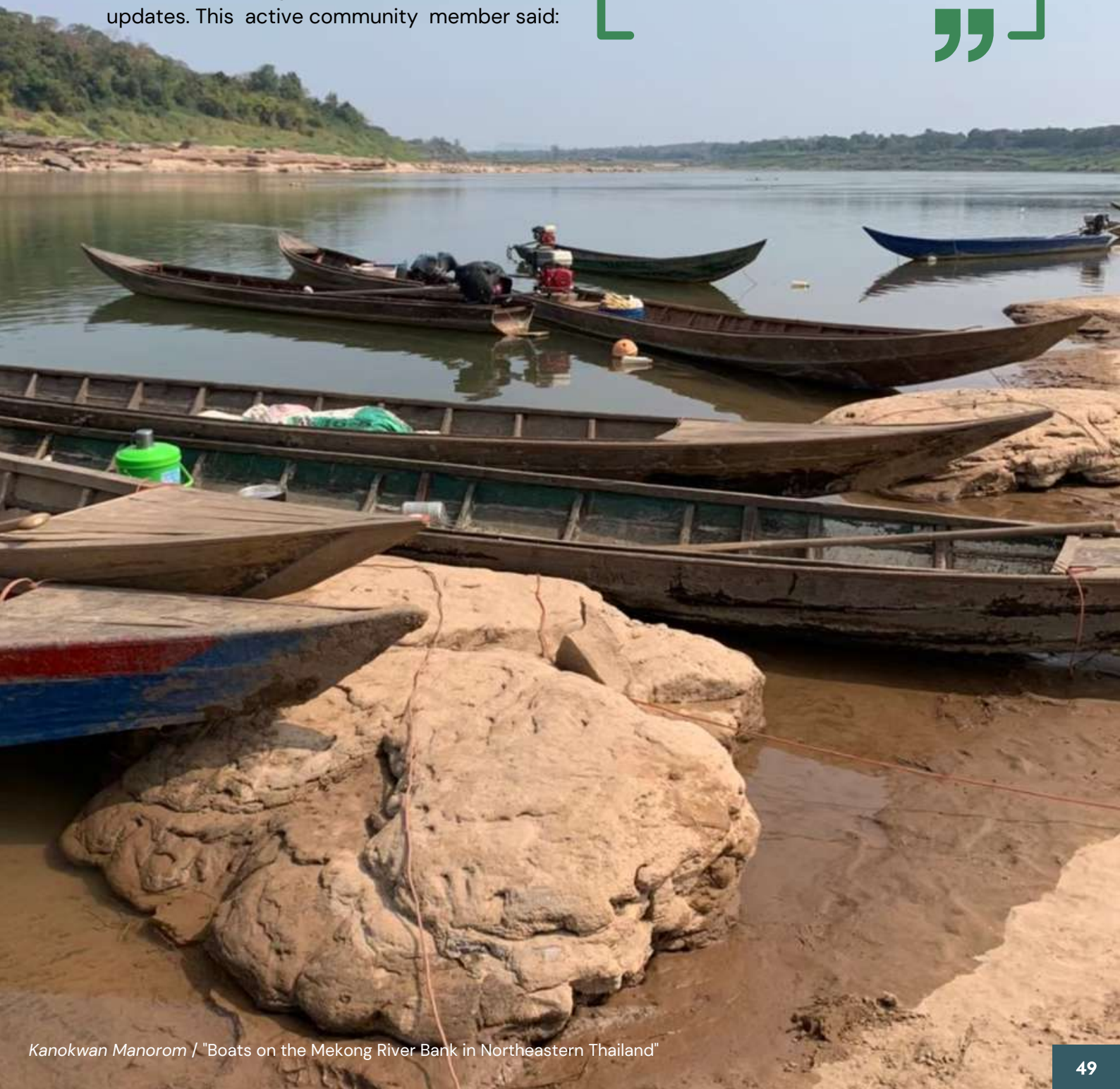
However, from our interviews in Phosai District of Ubon Ratchathani Province, local authorities and community members do not directly receive information from any government agencies through official channels, such as the Thai National Mekong Committee (TNMC), the Department of Water Resources (DWR), the Royal Irrigation Department (RID) or the Department of Fisheries (DoF) regarding the changing conditions of the Mekong River. The main reason is that there is no clear responsibility or mandate of these government authorities to share data with local authorities, despite the latter's close connection to the community members. Moreover, even between the line agencies there are still challenges to share data between them. The local authorities only organize water-related meetings regarding managing water availability to pump for irrigation, and there is no direct local policy on other aspects of the river's current condition.

When community members and the local authorities want to gather water data on the Mekong River, they tend to rely on their own networks. For example, in the village in Phosai District, one community member is active within the civil society network called "Network of Thai People in Seven Mekong Provinces in the Northeast." They share information via a LINE group, which has over 200 members, as well as via other social media such as Facebook. Here, community members share information about water levels in their own villages. Some DoF Officers who are also members in the group also sometimes share updates. This active community member said:

“

"I only know that there is a data sharing made available by the Mekong River Commission. But I do not understand it. I have never known when the water is released or not released and when released water arrives our village. It is unclear to me how to prepare and tell people in the village. It is difficult to estimate changes in water levels. That is why some boats and nets were washed away downstream or stuck on the rapids".

”



Among the community members and civil society interviewed, it was a broadly shared perspective that the water data provided by MRC was very difficult to understand and complicated to access, and was not easily available for community members without internet access. Many community members spoken with were not clear on the role of the MRC and TNMC, or aware of the new data sharing arrangements with China.

Asides from the LINE group and social media, other sources of information on the Mekong water levels were television, radio, and website pages. Words of mouth among fishers, friends and relatives from different villagers was also important, for example when they met at shared common fishing grounds. Here, they would comment on various indicators that they could observe on flow changes, such as the exposure of rocks, rapids, trees and wild vegetables, as well as erosion of river banks, and changes from fish, insects and birds. They also discuss on how changing flows affect water rituals in their villagers, including 'fireboats' and the floating water festivals.

Asides from the water level data, also important is the dissemination and response to advance warnings of changing water levels. Among local authorities and community members, there was no systematic way that they could receive advanced warnings on changing water levels. Moreover, even when they did hear that the water level might change, they thought that the announcement was not timely and/ or in error. One interviewed community leader said: "This

confusing information is not good for us to prepare our fishing activities keeping boat or fishing tools in safer places in advance." It was also mentioned that some of the fishing grounds do not have a reliable internet signal, so online sources are not available. Among those interviewed who were aware of the MRC and DWR websites, including government officers, they mentioned that language and complexity are barriers for using the MRC website, while the DWR website is more useable but the data was not in real time.

In terms of community members sharing their own knowledge about the changing water levels and its impacts to government line agencies, there are limited opportunities for them to do so regularly. Some civil society groups mentioned that they can share concerns with local Department of Fisheries officials, and that they had been informed that the Minister for Agriculture would convene a meeting on the issue. However, on a day-to-day basis, it was emphasized that data and information sharing was mainly within community networks, rather than with the government agencies. Some communities and civil society groups in Northeast Thailand have also in the past conducted local research (Thai Baan research) to document local livelihoods and the challenges faced, including to make policy recommendations, and it was recommended that such studies be conducted with the new challenges now faced on the changing water levels on the Mekong River.





Carl Middleton / Mekong River

Discussion

In this section, we draw together the preceding sections to focus on three lines of analysis: trends in the comprehensiveness and accessibility of scientific water data; recognition of diverse knowledge for transboundary water governance; and the opportunities and challenges for deepening water diplomacy and institutionalizing transboundary accountability.

Comprehensive and accessible scientific water data

There is a positive trend by governments towards making more quantitative water data publicly accessible on web-based platforms and via more comprehensive portals, including on the quantity and quality of water and river-connected ecosystems. This cooperation has been based on progressively deeper agreements between member states of the MRC, and also between China and the MRC. Basic water data on water level and rainfall is accessible in 'near real time' on the MRC platform, and for China's water monitoring stations also on the LMC website, the former of which is currently most comprehensive and has recently been significantly upgraded to make its data and information more organized and accessible.

This scientific water data is of value to government agencies, researchers and various types of think tanks who undertake research analysis and modeling of the Mekong-Lancang River. High quality research can generate information to evidence decision-making in transboundary water governance. However, as discussed above, research can also become politicized, contributing to tensions between states, and also with non-state actors. The politicization of research undermines the long-term credibility of information generated by scientific studies in the eyes of many actors.

Advanced warning of changing river conditions is based on accurate and timely availability of water data including the status and operation schedules of large hydropower dams and other

water infrastructure, combined with modelling analysis. For the lower basin, warning of changing river conditions, in particular flood and drought, is core to the MRC's activities. The MoU between the MRC and China on 19 July 2019 affirmed China's commitment to "to share any urgent information on any abnormal rise and fall in water level and discharge, and other information on the factors that might lead to sudden flood in the lower reaches of the basin." However, there remains a lack of clarity on the criteria by which "abnormal" will be defined and the timeframe within which advance notice would be provided. Moreover, the processes by which these announcements are subsequently communicated to riparian communities sufficiently in advance for them to prepare and accommodate the river changes predicted is not effective enough.

Water data sharing is also the foundation of evidence and analysis for improved decision making via impact assessment tools. In Southeast Asia (and globally) these tools have become increasingly incorporated into law and policy, and include varying degrees of public participation. To date, these have included environmental and social impact assessments (ESIA) for individual projects, and strategic environmental assessments (SEA) for the Mekong mainstream dam cascade (ICEM, 2010) and the region's electricity sector (ICEM, 2013). Deliberation of impact assessment is also integral to the MRC's PNPCA process. The use of these tools is a positive trend overall, although the mechanisms by which their findings and recommendations are incorporated into decision making requires further strengthening (Baird and Frankel, 2015, Dore et al., 2012).

Diversity of water knowledge

It is now widely recognized that for inclusive and sustainable development to take place, multiple forms of knowledge are required in

addition to 'scientific knowledge', including situated community knowledge, civil society-led research, as well as political and practical forms of knowledge (van Kerkhoff and Lebel, 2006, Leach et al., 2010). All forms of knowledge have their strengths and limitations and should be combined together to co-produce 'actionable' water data that can enhance governance, which nowadays is increasingly achieved through 'integrative' or 'transdisciplinary' research and 'knowledge co-production' strategies (Schuttenberg and Guth, 2015). Within the Mekong basin, for example, there has been a growing number of community-led research initiatives (Scurrah, 2013) and co-produced knowledge between community, civil society, academics and local government agencies (Middleton et al., 2019b). The emphasis on water data sharing to date has been on scientific data between governments, to be shared with the public. This also reveals a hierarchy of knowledge that privileges scientific knowledge (Fox and Sneddon, 2019). As emphasized in Section 6, the scope of this discussion could be expanded to recognize the value of exchanging and combining multiple forms of water knowledge that would strengthen relationships and trust between state and non-state actors, improve public participation, and co-produce new actionable water knowledge. Regarding facilitating meaningful public participation, the existing domestic laws in the six countries sharing the Mekong-Lancang River are uneven. However, there are a diversity of mechanisms and arenas within which public participation takes place that can be expanded at the national and transnational level, including within the MRC (Boer et al., 2016).

Deepening water diplomacy and institutionalizing transboundary accountability

In the Mekong-Lancang basin, recognizing that there is simultaneously tension and

and cooperation across a wide range of issues related to transboundary water sharing there is growing interest in the role of water diplomacy (Zhang and Li, 2020, Kittikhoun and Staubli, 2018). Water diplomacy is often understood as focusing on the state-to-state processes to resolve transboundary water issues through dialogue and cooperation (Klimes et al., 2019, Islam and Madani, 2012). These processes occur within water governance institutions such as the MRC, broader institutions that relate to water such as the LMC, and at higher levels of foreign affairs and diplomacy. State-to-state reciprocity is a crucial process within water diplomacy, in which outcomes must be viewed as 'equitable enough' (Middleton and Devlaeminck, 2020). Thus, there has also been attention to the influence of power asymmetries between states that the influence outcomes of water diplomacy (Vij et al., 2020, Warner and de Man, 2020), and to the role of non-state actors involved in 'informal water diplomacy' in influencing the state-to-state level water diplomacy processes (Mirumachi, 2020).

To date, intergovernmental water diplomacy has prioritized on setting in place agreements for water data sharing within the MRC and between China and the MRC. These are important foundations to inform

transboundary water governance. Yet, increased transparency through the availability of water data does not in itself result in changed practices on managing water infrastructure that is accountable to affected riparian communities, civil society and the wider public. Some MRC Procedures, in particular the MRC's PNPCA, have been established to facilitate notification, prior consultation and agreement between MRC member States that also reflect the principles of international customary law (section 3). The PNPCA has also includes a degree of public consultation, although the quality of public consultation has varied between countries involved in the process (Middleton and Pritchard, 2016, Boer et al., 2016). In practice, the outcome of PNPCA's have resulted in mixed evaluations on their effectiveness both from the perspective of states and riparian communities and civil society (Kittikhoun and Staubli, 2018, Rieu-Clarke, 2015). In contrast, there is not presently a clear rules-based regime in place on the operation of hydropower projects on the Lancang River that create changes to the downstream Mekong River that would establish accountability mechanisms between the operation of the Lancang hydropower cascade and its impacts on the downstream.



Conclusion and Policy Directions: Water data sharing and accountable transboundary governance

In this report, we examine how water data and information sharing is a key policy issue for transboundary water governance on the Mekong-Lancang River. In this concluding section, we address the main research question: “What options exist for improved evidence-based transboundary water governance between state actors and inclusive of non-state actors in the Mekong-Lancang basin building on recent improvements in basin-wide water data sharing?”. We summarize the report’s key findings and analysis, and suggest policy directions on comprehensive and accessible scientific water data, diversity of water knowledge, and deepening water diplomacy and institutionalizing transboundary accountability.

In this report, we outlined international good practice in water data sharing. The section summarized customary international law and existing conventions/ directives on transboundary rivers, namely the 1997 Watercourses Convention; the 1992 Water Convention; and the EU Water Framework Directive. We also provided an overview of the Good Practice Guidelines for Water Data Management Policy. Across these agreements, it is highlighted that sharing water data and information is a foundational component of attaining equitable and reasonable utilization of transboundary water resources, and is also necessary to fulfill the due diligence obligation not to cause significant harm. Exchange of water data and information is undertaken in good faith between states and facilitates cooperation and joint management, as well as building trust and informs evidence-based decision making. Moreover, across the good practices surveyed, the availability of data to the public (or ‘open data’) is generally favored, given that it can increase trust by the public in states and state-facilitated decision making, increase public participation and accountability, and improve economic and social outcomes and sustainable development.



We have also outlined existing water data sharing arrangements: between the MRC member states; between China and the MRC; and via the LMC. Within the framework of the Mekong Agreement, a series of Procedures have been progressively approved by the MRC member states that has facilitated intergovernmental data sharing between them via the MRC's Information System. Much of this data and information is also publicly available via the MRC's website and data portal, which have been recently revamped, and includes 'near real time' hydrometeorological monitoring. However, the data shared is not complete, with important gaps being only partial water data for the upper portion of the basin in China and on the operation and mitigation measures of mainstream and tributary hydropower projects in the lower basin.

Water data sharing between China and the MRC has progressively expanded since 2002, and since November 2020 is at its most extensive with hourly water data shared twice per day from two monitoring stations at Jinghong and Ma'an that is published on both the MRC's and LMC's websites. In addition to this water data sharing, the MRC Secretariat and the LMWRCC have progressively deepened their cooperation, including signing an MoU in December 2019 that expresses a commitment to data and information exchange, basin-wide monitoring, and joint assessment on Mekong water and related resources, and that initiated a joint research on the causes of the 2019 low river flows, which is yet to be published. Within the LMC framework the member states have also committed to data and information sharing among a range of project and activities, and an important step towards this was the launch of the LMWRCC Information Sharing Platform in December 2020 that has continued to expand its content. There are several other online platforms in addition to those of the MRC and LMC, including the Mekong Dam Monitor that presents data monitoring the status of hydropower

reservoirs in the Mekong-Lancang basin.

Overall, the extent of water data information shared between the region's governments and made available to the public via online platforms has expanded over time resulting in improved transparency, although the water data shared and its analysis is still incomplete, creating uncertainty on the status and explanation of river conditions in the Mekong-Lancang basin, especially at times of extreme low flow and flooding.

The report has analyzed the hydropolitics of low flows during 2019–2020 in the Mekong-Lancang River, and in particular how these hydropolitics were influenced by research published at the time, and intensified by geopolitical tensions between the US and China. A study based on satellite data on the 2019 low flows by Basist and Williams (2020) led to intense debate over the role of mainstream hydropower projects in China, including by other researchers some of who raised questions towards the research's method and conclusions, and more broadly in various media and political arenas. The public debate in 2020 over the 2019 flood at times overstated actual research findings and often produced simplified narratives of blame, given that all research presented at the time was conducted with incomplete water data due to a lack of public access. The announcement in October 2020 that China would make available all-year-round water data from two monitoring stations on the Lancang River partly address these water data gaps. However, there remains scope for China to expand water data sharing further to address remaining gaps that could otherwise perpetuate a degree of uncertainty, and also for MRC member states to widen the scope of their data sharing to operational data for mainstream and tributary hydropower projects in the lower basin.

We have presented empirical evidence from two case studies in North and Northeast

Thailand. Interviewees from villages in both region had observed unseasonal changes in the river since a decade ago, in terms of water level, color and flow, which had affected river and wetland ecosystems and their fishing and riverbank gardening practices and livelihoods. The section detailed two Thai-language online platforms managed by the Office of National Water Resources (ONWR) and the Bureau of Research, Development and Hydrology and the form of data tables and infographics available. The water data presented is a combination of Thai Government data and data received from the MRC. However, our community level interviews found that few people used the Thai government platforms nor the MRC or LMC platforms directly. Rather, people living in riparian communities tend to circulate information among themselves in person or via Facebook or LINE sourced from media, civil society groups, other fishers or boat operators. For riparian communities, perhaps more important than real-time water level data was receiving advanced warnings on changing water levels and its consequences, which at present many interviewees considered to be not timely nor accurate. It was also found that there were limited channels available for people living in riparian villages to communicate their knowledge and concerns to the Thai government or to regional institutions.

Based on the findings of this report, and the analysis in the preceding section, we suggest the following policy directions:

On comprehensive and accessible scientific water data:

- Continue to expand the geographical scope, number of monitoring stations and comprehensiveness of water data and information shared between governments and placed in the public domain via the MRC and LMC data portals. This includes: on the Lancang River to cover all eleven hydropower dams in operation including data on upstream and downstream water levels and flows and operation schedule; the operation of tributary projects throughout the basin that influence flood and drought conditions locally and cumulatively; and from the Mekong mainstream dams in Laos now in operation. Regarding the latter, the MRC's JEM project is intended to address this policy gap.
- Expand the scope of scientific water data sharing to include data on water quality (sediment, pollution levels etc) and ecosystem status. Basin wide cooperation could build from the existing Procedures agreed between the MRC member states (PDIES, PMFM, PWUM and PWQM).
- Place historical water data in the public domain from water monitoring stations that nowadays share data following recent intergovernmental agreements.
- Scientific research undertaken by government agencies, researchers and various types of think tanks should be publicly accountable, for example by presentation in research conferences and/or undergoing processes of peer review. This could be guided by the concept of 'open data' and the recommendations of the Good Practice Guidelines for Water Data Management Policy (Bureau of Meteorology, 2017).
- Encourage collaboration between research groups across the region to undertake joint research and build shared understanding on research findings and analysis. Relatedly, encourage "plural" science and the deliberation of conflicting data and its interpretation as part of the scientific research process.
- To ensure research is credible, follow standard procedures on peer review and presentation in researcher conferences, and clearly communicate research limitations.
- Work towards an additional intergovernmental agreements between China and the MRC to detail the specific parameters and timeframes for sharing advanced warning on changing

river conditions, including on defining “abnormal rise and fall” of the river that would be the basis of sharing advanced warning.

- Forecast more specific predictions of changing water levels that account for the geographic variations of each riparian village’s location.^(xlii)
- Conduct research on how to pro-actively communicate trusted emergency information simply, quickly and effectively, including evaluating innovative new channels such as the MRC’s partnership with Facebook, as well as via messenger groups such as LINE that community networks have already created themselves, and the utility of longer standing platforms such as the web-based portals of national governments and the MRC. The role of other actors who help share information including media outlets, local civil society, and community-to-community networks should also be recognized and supported.
- Systematize communication channels between local government authorities and government line agencies hosting water data and emergency announcement information to assist in timely information being delivered directly to riparian communities. Relatedly, government agencies working at the province and national levels should work together and routinely visit local areas to inform people in riparian villages about water data and listen to their concerns about the experienced impact of changes in water levels that affect fishing and related livelihoods activities.
- Deepen legislation on impact assessment tools into water and energy related decision-making processes, systematically connecting them to public participation processes. MRC member states could also approve the Procedures on Transboundary Environmental Impact Assessment.

On diversity of water knowledge:

- Establish mechanisms within the MRC and LMC platforms, as well as national government agencies, to receive information and analysis from non-state actors as a basis for ongoing exchange of knowledge and public participation in transboundary water governance. This could include exchange visits, for example through the LMC people-to-people exchange program.
- The MRC and LMC could co-organize multi-stakeholder dialogues to generate a more complete picture of the Mekong–Lancang River and its diverse economic, social and cultural values, together with the impacts experienced by riparian communities due to the changing river conditions.
- Research funding agencies should extend support to community-led, civil society, academic, and think tank research – including co-produced research together with state actors – to ensure that diverse forms of knowledge are produced that can contribute evidence to decision-making in transboundary water governance.
- Government agencies working at the provincial and national levels should work together and routinely visit local areas to inform people in riparian villages about water data and listen to their concerns.
- Develop research initiatives in which state and non-state actors can meaningfully collaborate to co-produce integrative transboundary knowledge, including research on community-level impacts of changing river conditions, and research that integrates and triangulates scientific water data with the situational knowledge of riparian communities, local and regional government officers and civil society combining the expertise of all actors. Collaboration between academic institutes in the region could facilitate such a regional research agenda.

On deepening water diplomacy and institutionalizing transboundary accountability:

- Building from improved water data and information sharing, there should be intergovernmental discussion on establishing an institutionalized rules-based regime for the entire Lancang-Mekong basin that is founded on meaningful dialogue, reciprocity and trust both between states and with communities and civil society. The Watercourses Convention outlines principles and practices for this, including equitable and reasonable utilization and the due diligence obligation not to cause significant harm, and could be the basis of a framework of discussion (Zhong et al., 2016, Middleton and Devlaeminck, 2020). A starting point could be a joint study on the existing legal rules, customary principles, pledges, and regional agreements (such as the MRC's Procedures) maintained by each state actor to identify points of commonality and difference and how these could structure basin-wide rules-based cooperation.
- Intergovernmental cooperation and water diplomacy on water data sharing and transboundary accountability of water infrastructure should incorporate mechanisms for meaningful participation of people living in riparian communities and other stakeholder including civil society groups, academics and think tanks. Better public participation and greater transparency and accountability including via 'open data' are the precondition for trust building and conflict reduction both within and between countries.
- Through deepening water diplomacy and rules-based institutionalization, work towards restoring a minimum natural hydrological regime in consultation with riparian communities that minimizes the impacts of hydropower dam operation on ecosystems and wetlands.



- [i] Customary international law is unwritten law that forms due to consistent State practice and opinio juris, the belief that a State is obligated to act in a certain way according to the law, over an unspecified period of time.
- [ii] Good faith is a foundational principle of international law, requiring a State to act honestly and in good intention.
- [iii] <https://portal.mrcmekong.org/procedure/pwum-overview>
- [iv] <https://www.mrcmekong.org/our-work/functions/basin-monitoring/water-quality-monitoring/>
- [v] <https://portal.mrcmekong.org/procedure/pnpca-overview>
- [vi] <https://portal.mrcmekong.org/procedure/pnpca-overview>
- [vii] <https://pmfm.mrcmekong.org/>
- [viii] <http://interactive.mrcmekong.org/mrc-annual-report-2019/outcome-6-story-1/>
- [ix] <http://interactive.mrcmekong.org/mrc-annual-report-2019/outcome-6-story-2/>
- [x] <https://www.mrcmekong.org/news-and-events/news/facebook-joins-with-mekong-river-commission-to-raise-awareness-about-flood-and-drought-in-the-mekong/>
- [xi] <https://www.mrcmekong.org/news-and-events/news/pilot-program-to-monitor-impacts-from-xayaburi-and-don-sahong-takes-off/>
- [xii] <https://www.mrcmekong.org/about/mrc/dialogue-partners/>
- [xiii] <https://www.mrcmekong.org/publications/governance/minutes-of-the-meetings/>
- [xiv] <https://www.mrcmekong.org/news-and-events/news/pr001-06102021/>
- [xv] <https://www.mrcmekong.org/news-and-events/news/mekong-water-levels-to-drop-due-to-dam-equipment-testing-in-china/>
- [xvi] <https://www.mrcmekong.org/news-and-events/news/water-flow-from-chinas-jinghong-dam-to-decrease/>
- [xvii] <https://www.mrcmekong.org/news-and-events/news/water-flow-from-chinas-jinghong-station-to-fluctuate-but-no-major-impact-is-expected/>
- [xviii] <https://www.mrcmekong.org/news-and-events/news/water-flow-in-jinghong-of-china-to-decrease-but-without-significant-impact-downstream/>
- [xix] Twice per day is stated in the MRC Press Release on 22 October 2020. However, on the MRC portal, it states “Data from the two stations in China (Jinghong and Ma’an) are sent hourly throughout the whole year under the Agreement between the Ministry of Water Resources of China and the Mekong River Commission.” (<https://portal.mrcmekong.org/monitoring/river-monitoring-telemetry>)
- [xx] The study was to be finalized in September 2020, although its current status is not publicly known.
- [xxi] According to the MRC Press Release at the time, the study would be completed by September 2020. However, as of the time of writing, the report does not appear to be publicly available.
- [xxii] The study builds from an earlier study jointly published in October 2016 between the MRC and Ministry of Water Resources of China titled “Joint Observation and Evaluation of the Emergency Water Supplement From China to the Mekong River.”
- [xxiii] https://www.vientianetimes.org.la/freeContent/FreeContent_Realizing163.php
- [xxiv] http://www.xinhuanet.com/english/2020-08/24/c_139314536.htm
- [xv] https://www.fmprc.gov.cn/mfa_eng/wjbxw/t1837496.shtml
- [xvi] <https://www.stimson.org/2020/mekong-infrastructure-tracker-tool/>
- [xvii] <https://www.stimson.org/2020/new-evidence-how-china-turned-off-the-mekong-tap/> ; The interactive multimedia article stated: “For six months in 2019, China’s dams held back so much water that they entirely prevented the annual monsoon-driven rise in river level at Chiang Saen, Thailand. This has not happened since modern records have been kept”
- [xviii] For example, in September 2020, launched the Mekong US Partnership, which upgraded the previous Lower Mekong Initiative.
- [xix] During the flood season, when the water levels can change quickly, the Bureau of Research, Development and Hydrology website may be updated on a daily basis
- [xxx] Color coding indicates the river level against a ‘crisis level’, where Green = normal; Yellow = needs to be monitored; and Red = very low water level or crisis water level.
- [xxxi] Color coding indicates an increase (pink), stable (blue) or decreasing (brown) water level change.
- [xxxii] <https://monitoring.mrcmekong.org/station/O92600> and <https://monitoring.mrcmekong.org/station/O92980>. Note, this data, excluding rainfall data, is also available via http://www.lmcwater.org.cn/water_information/hydrological_data/
- [xxxiii] http://www.lmcwater.org.cn/water_information/regulation_information/
- [xxxiv] <http://division.dwr.go.th/brdh/index.php/th/>
- [xxxv] This section was researched by Apisom Intralawan, Ph.D, the Institute for the Study of Natural Resources and Environmental Management (NREM), Mae Fah Luang University, Thailand. It presents a summary of the research report prepared.
- [xxxvi] In some areas of lost wetland, the land is now used to grow corn which benefits some local farmers in the short term.
- [xxxvii] At the time of research, the digital display had recently broken and it was unclear when it would be repaired.
- [xxxviii] For example, reviewing river level data on the Department of Water Resource Management website on March 3, 2021 revealed the latest information available was from February 25, 2021.
- [xxxix] <http://www.lmcwater.org.cn/LmStation/index-en.html?STCD=90201600> and <http://www.tnmc-is.org/>
- [xl] Some civil society groups interviewed also mentioned about the ineffectiveness of the MRC in general, as well as the Procedures on Notification, Prior Consultation and Agreement (PNPCA) for lower Mekong mainstream dams.
- [xli] This section was researched by Associate Professor Kanokwan Manorom, Ph.D, Mekong Sub-region Social Research Center, Ubon Ratchathani University, Thailand. It presents a summary of the research report prepared.
- [xlii] One interviewee analogized this to ‘the same format as weather forecast data’.

Appendix: References

- BAIRD, M. & FRANKEL, R. 2015. Mekong EIA Briefing: Environmental Impact Assessment Comparative Analysis In Lower Mekong Countries. Bangkok: PACT.
- BASIST, A. & WILLIAMS, C. 2020. Monitoring the Quantity of Water Flowing Through the Mekong Basin Through Natural (Unimpeded) Conditions. Bangkok: Sustainable Infrastructure Partnership.
- BIBA, S. 2018. China's 'old' and 'new' Mekong River politics: the Lancang-Mekong Cooperation from a comparative benefit-sharing perspective. *Water International*, 1–20.
- BOER, B., HIRSCH, P., JOHNS, F., SAUL, B. & SCURRAH, N. 2016. *The Mekong: A Socio-legal Approach to River Basin Development*, Abingdon and New York, Earthscan.
- BROWDER, G. & ORTOLANO, L. 2000. The evolution of an international water resources management regime in the Mekong River basin. *Natural Resources Journal*, 40, 499–531.
- BUREAU OF METEOROLOGY 2017. Good practice guidelines for water data management policy: World Water Data Initiative. Melbourne: Bureau of Meteorology.
- DORE, J., LEBEL, L. & MOLLE, F. 2012. A framework for analysing transboundary water governance complexes, illustrated in the Mekong Region. *Journal of Hydrology*, 466–467, 23–36.
- EVERS, J. & PATHIRANA, A. 2018. Adaptation to climate change in the Mekong River Basin: introduction to the special issue. *Climatic Change*, 149, 1–11.
- FOX, C. & SNEDDON, C. 2019. Political Borders, Epistemological Boundaries, and Contested Knowledges: Constructing Dams and Narratives in the Mekong River Basin. *Water*, 11, 413.
- GLOBAL TIMES. 2020. Sustainable and practical mutual assistance among Mekong River countries remains despite of coronavirus. *Global Times*, 23 August.
- HAFFNER, A. 2020. 'Us' vs 'them': The politics dictating the rise and fall of the Mekong. *The Southeast Asia Globe*, 23 April.
- HU, Y. & LIN, X. 2020. US-backed institutions' hyping China's 'dams threat' in Mekong River riddled with loopholes: expert. *Global Times*, 11 September.
- ICEM 2010. *Strategic Environmental Assessment Of Hydropower On The Mekong Mainstream: Final Report*. Hanoi.
- ICEM 2013. *Impact Assessment Report: Ensuring Sustainability of GMS Regional Power Development (Draft Prepared for ADB – TA – 7764 REG)*. Hanoi: International Centre for Environmental Management (ICEM) Asia.
- ISLAM, S. & MADANI, K. 2012. *Water Diplomacy: A Negotiated Approach to Managing Complex Water Networks*, London and New York, Routledge.
- JOHNSON, K. & WONGCHA-UM, P. 2020. Water wars: Mekong River another front in U.S.–China rivalry. *Reuters*, 24 July.
- KALLIO, M. & FALLON, A. 2020. Are China's dams on the Mekong causing downstream drought? The importance of scientific debate [Online]. Available: <https://www.csdscchula.org/publications/2020/4/28/critical-nature-are-chinas-dams-on-the-mekong-causing-downstream-drought-the-importance-of-scientific-debate> [Accessed].
- KALLIO, M., RASAENEN, T. & KETELSEN, T. 2020. Drought Characteristics of Lancang-Mekong River Basin and the Impacts of Reservoir Regulation on Streamflow: Comment in response to journalistic enquiry.
- KETELSEN, T., RÄSÄNEN, T. & SAWDON, J. 2020a. Did China turn off the Lower Mekong? Why data matters for cooperation. *Southeast Asia Globe.com*.

- KETELSEN, T., SAWDON, J. & RASAENEN, T. 2020b. Monitoring the Quantity of water flowing through the Upper Mekong Basin under natural (unimpeded) conditions: Rapid Review. Australia-Mekong Partnership for Environmental Resources & Energy systems (AMPERES).
- KINNA, R. & RIEU-CLARKE, A. 2017. The Governance regime of the Mekong River Basin: Can the Global Water Conventions Strengthen the 1995 Mekong Agreement? *International Water Law*, 21, 1–84.
- KISHIMOTO, M. 2020. US and China lock horns over Mekong River data management. *Nikkei Asian Review*, 10 September.
- KITTIKHOUN, A. & STAUBLI, D. M. 2018. Water diplomacy and conflict management in the Mekong: From rivalries to cooperation. *Journal of Hydrology*, 567, 654–667.
- KLIMES, M., MICHEL, D., YAARI, E. & RESTIANI, P. 2019. Water diplomacy: The intersect of science, policy and practice. *Journal of Hydrology*, 575, 1362–1370.
- LEACH, M., SCOONES, I. & STIRLING, A. 2010. *Dynamic Sustainabilities: Technology, Environment, and Social Justice*, Abingdon, Earthscan.
- LEB, C. 2019. Data Innovations for Transboundary Freshwater Resources Management: Are Obligations Related to Information Exchange Still Needed? *International Water Law*, 4, 3–78.
- LU, X. X., LI, S., KUMMU, M., PADAWANGI, R. & WANG, J. J. 2014. Observed changes in the water flow at Chiang Saen in the lower Mekong: Impacts of Chinese dams? *Quaternary International*, 336, 145–157.
- MIDDLETON, C. & ALLOUCHE, J. 2016. Watershed or Powershed?: A critical hydropolitics of the ‘Lancang–Mekong Cooperation Framework. *The International Spectator*, 51, 100–117.
- MIDDLETON, C. & DEVLAMINCK, D. J. 2020. Reciprocity in practice: the hydropolitics of equitable and reasonable utilization in the Lancang–Mekong basin. *International Environmental Agreements: Politics, Law and Economics*.
- MIDDLETON, C., DEVLAMINCK, D. J. & WIDYASARI, A. 2019a. “Shaping The Future Of Mekong Regional Architecture: Reinforcing Transboundary Water Governance Through Reciprocity” (Published on 27 June 2019 at the Mekong Policy Dialogue: Evolving sub-regional architecture and ACMECS”, Banyan Tree Hotel, Bangkok, 27 June 2019. Bangkok: Center for Social Development Studies.
- MIDDLETON, C., MANOROM, K., NGUYEN, V. K., SOUKKHY, O. & SALAMANCA, A. 2019b. Exploring Approaches Towards Co-produced Knowledge for Wetland and Agro-ecological Knowledge: Co-production for Recovering Wetlands, Agro-ecological Farming and Livelihoods in the Mekong Region. In: KRITTASUDTHACHEEWA, C., NAVY, H., TINH, B. C. & VOLADET, S. (eds.) *Development and Climate Change in the Mekong Region*. Gerakbudaya, Malaysia: SIRD.
- MIDDLETON, C. & PRITCHARD, A. 2016. Arenas of Water Justice on Transboundary Rivers: A Case Study of the Xayaburi Dam, Laos. In: BLAKE, D. J. H. & ROBINS, L. (eds.) *Water Governance Dynamics in the Mekong Region*. Petaling Jaya: Strategic Information & Research Development Centre.
- MIRUMACHI, N. 2020. Informal water diplomacy and power: A case of seeking water security in the Mekong River basin. *Environmental Science & Policy*, 114, 86–95.
- MRC 1995. Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin, 5 April 1995, Mekong River Commission.
- MRC 2002. China signs data-sharing agreement. *Mekong News*, 2, 1–2.
- MRC 2011. 1995 Mekong Agreement and Procedures. Vientiane: Mekong River Commission (MRC).
- MRC 2019a. Mekong River’s aquamarine hue likely to occur elsewhere due to low flows, bringing possible risks. Vientiane: MRC (Mekong River Commission).
- MRC 2019b. Mekong water levels to drop due to dam equipment testing in China. Vientiane: Mekong River Commission.

MRC 2019c. MRC and China renew pact on water data provision and other cooperation initiatives. Vientiane: Mekong River Commission (MRC_).

MRC 2019d. MRC Secretariat, LMC Water Center ink first MOU for better upper-lower Mekong management (18 December 2019). Vientiane: Mekong River Commission Secretariat (MRCS).

MRC 2019e. State of the Basin Report 2018. Vientiane, Lao PDR: Mekong River Commission.

MRC 2020a. China to provide the Mekong River Commission with year-round water data. Vientiane: MRC (Mekong River Commission).

MRC 2020b. Mekong countries urged to address low water flows: Mekong River Commission. Vientiane: MRC.

MRC 2020c. Stakeholders visiting Xayaburi dam continue calling for the developer to share operation rules, environmental monitoring data. Vientiane: MRC (Mekong River Commission).

MRC 2020d. Understanding the Mekong River's hydrological conditions: A brief commentary note on the "Monitoring the Quantity of Water Flowing Through the Upper Mekong Basin Under Natural (Unimpeded) Conditions" study by Alan Basist and Claude Williams (2020). Vientiane: MRC Secretariat.

MRC 2020e. Weekly Dry Season Situation Report for the Mekong River Basin Prepared on: 07/01/2020, covering the week from 31 Dec 2019 to 5 Jan 2020. Vientiane: Mekong River Commission,.

MRC, LMWRCC, CIWRHR & IWMI 2019. Hydrological Impacts of the Lancang Hydropower Cascade on Downstream Extreme Events. Mekong River Commission (MRC), Lancang-Mekong Water Resources Cooperation Centre (LMWRCC), China institute of Water Resources and Hydropower Research (CIWRHR), International Water Management Institute (IWMI).

NEW YORK TIMES. 2020. China Limited the Mekong's Flow. Other Countries Suffered a Drought. New York Times, 13 April.

RÄSÄNEN, T. A., SOMETH, P., LAURI, H., KOPONEN, J., SARKKULA, J. & KUMMU, M. 2017. Observed river discharge changes due to hydropower operations in the Upper Mekong Basin. *Journal of Hydrology*, 545, 28–41.

RIEU-CLARKE, A. 2015. Notification and Consultation Procedures Under the Mekong Agreement: Insights from the Xayaburi Controversy. *Asian Journal of International Law*, 5, 143–175.

SCHUTTENBERG, H. Z. & GUTH, H. K. 2015. Seeking our shared wisdom: a framework for understanding knowledge coproduction and coproductive capacities. *Ecology and Society*, 20.

SCURRAH, N. 2013. "Countering hegemony" and "institutional integration": Two approaches to using Tai Baan research for local knowledge advocacy. In: DANIEL, R., LEBEL, L. & MANOROM, K. (eds.) *Governing the Mekong: Engaging in the Politics of Knowledge*. Selangor: Strategic Information and Research Development Center.

THU, H. N. & WEHN, U. 2016. Data sharing in international transboundary contexts: The Vietnamese perspective on data sharing in the Lower Mekong Basin. *Journal of Hydrology*, 536, 351–364.

TIAN, F., LIU, H., HOU, S., LI, K., LU, H., NI, G. & MU, X. 2020a. Drought Characteristics of Lancang-Mekong River Basin and the Impacts of Reservoir Regulation on Streamflow. Beijing: Centre for International Transboundary Water and Eco-Security, Tsinghua University, Department of Hydraulics, China Institute of Water Resources and Hydropower Research.

TIAN, F., LIU, H. & LU, H. 2020b. Trust key to Lancang-Mekong cooperation. *ChinaDaily*, 25 August.

VAN KERKHOFF, L. & LEBEL, L. 2006. Linking Knowledge and Action for Sustainable Development. *Annual Review of Environment and Resources*, 31, 445–477.

- VIJ, S., WARNER, J. & BARUA, A. 2020. Power in water diplomacy. *Water International*, 45, 249–253.
- WARNER, J. & DE MAN, R. 2020. Powering hydrodiplomacy: How a broader power palette can deepen our understanding of water conflict dynamics. *Environmental Science & Policy*, 114, 283–294.
- WILLIAMS, J. M. 2020. Is three a crowd? River basin institutions and the governance of the Mekong River. *International Journal of Water Resources Development*, 1–21.
- ZHANG, H. & LI, M. 2020. China's water diplomacy in the Mekong: a paradigm shift and the role of Yunnan provincial government. *Water International*, 1–18.
- ZHONG, Y., TIAN, F., HU, H., GREY, D. & GILMONT, M. 2016. Rivers and reciprocity: perceptions and policy on international watercourses. *Water Policy*, 18, 803–825.
-

