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New transboundary water resources cooperation for Greater Mekong Subregion: the Lancang-Mekong Cooperation

Ren Junlin[a,*], Peng Ziqian[b] and Pan Xue[a]

[a]*Accounting College of Wuhan Textile University, 430200, Wuhan, China*

**Corresponding author. E-mail: 85194331@qq.com*

[b]*School of Economics and Management Hubei University of Technology, 430068, Wuhan, China*

Abstract

The Lancang-Mekong Cooperation (LMC) is a new type of regional cooperation mechanism in the Greater Mekong Subregion (GMS). It was officially co-founded by six Lancang-Mekong countries in 2016. Water resources cooperation is the flagship field of the LMC. The goal of this article is to introduce comprehensively the LMC and to illustrate why it can be regarded as a new choice for regional water resources cooperation in the GMS. This paper first reviews the background to LMC's foundation, and then introduces the structural framework, operating mechanism and recent advances of the LMC. It will then analyze the deficiencies of the present water resources cooperation mechanisms in the GMS and the comparative advantages of water resources cooperation under LMC. Finally, some suggestions were given to improve and reinforce water resources cooperation under the LMC. This research concludes that the LMC is more suitable for the actual needs and objective reality of Lancang-Mekong countries owing to its high-level and all-round regional cooperation mechanism. It was established jointly by all riparian states, with a shared vision to enhance the well-being of six countries' people, and works to narrow the development gap among regional countries.

Keywords: Greater Mekong Subregion (GMS); Lancang-Mekong Cooperation; Lancang-Mekong River; Transboundary river; Water resources cooperation

Highlights

- Demonstrating the LMC is a new type of regional cooperation mechanism.
- Discussing the advances and advantages of water cooperation under the LMC.
- Summarizing the deficiency of existing organizations in water cooperation in the GMS.
- Challenges and solutions of water cooperation under the LMC are analyzed.

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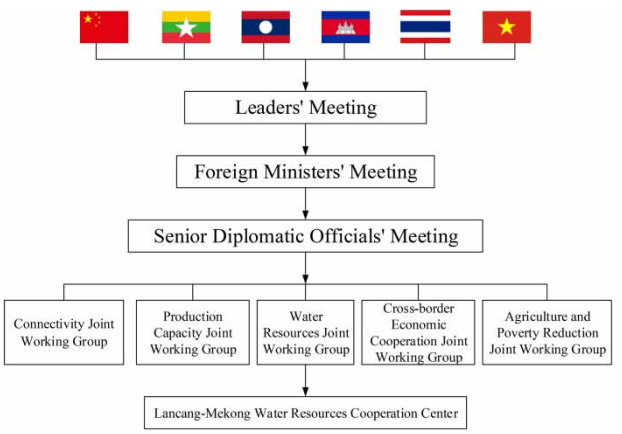
Graphical Abstract



1. Introduction

The Lancang-Mekong River is an important international river in Asia that originated in the Tibetan plateau. It has a length of 4,909 km and a drainage area of 795,000 km^2 (Shaochuang *et al*., 2007; Kummu *et al*., 2008). The upstream of the Lancang-Mekong River in China is known as Lancang River, and the lower in the Indo-China Peninsula is called the Mekong River. The Lancang-Mekong River flows through six countries (Figure 1). These regions are known as the GMS and are made up of the People's Republic of China (PRC, specifically Yunnan Province and Guangxi Zhuang Autonomous Region), the Republic of the Union of Myanmar (Myanmar), the Lao People's Democratic Republic (Lao PDR), the Kingdom of Cambodia (Cambodia), the Kingdom of Thailand (Thailand) and Socialist Republic of Vietnam (Vietnam) (Krongkaew, 2004; Krongkaew *et al*., 2005; Cui *et al*., 2012). China and the other five Mekong countries are linked together by the Lancang-Mekong River. It has a surface of 2.6 million km^2 (Luanglatbandith & Mission, 2007) and a combined population of about 326 million (Islam, 2012).

In recent years, rapid economic growth and growing population pressures have resulted in steadily increasing pressure on the supply of water resources and the water's ecological environment. Consequently, owing to the pressure to maintain standards in this area, the Lancang-Mekong countries pay great attention to rational utilization and scientific management of their water resources. But the positive or negative externalities of water-using and river-protecting issues make it complex to manage an international river. Accordingly, the finiteness of resources and the particularity of the international river need all stakeholders to cooperate in water resource use and management (Barret, 1994; Yoffe *et al*., 2003; Douven *et al*., 2014).

Nevertheless, the demands and targets of each country in this basin are varied due to many factors, some of which include geographical locations, developmental stages and industrial structure (Claudia Ringler, 2004). Officials in Laos preferred to build hydropower dams to generate more electricity. They will then sell this power to Thailand who are hoping to get more hydropower to ensure their economic and social development. Concurrently, Thailand also plans to withdraw more water from Mekong

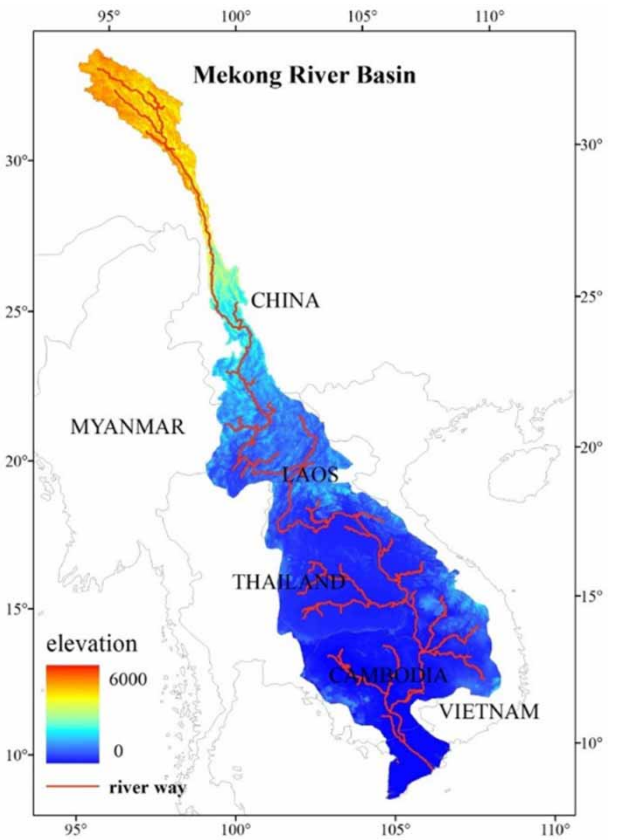


Fig. 1. Lancang-Mekong River basin.

to irrigate its farmland in the north. Similarly, Cambodia is more attentive to its fishery policy and approach in Tonle Sap Lake and agricultural production in floodplains. Vietnam wishes to maintain the flow in the Mekong Delta to resist sea water intrusion. China wants to carry out comprehensive development, including cooperation with downstream countries. In general, the downstream countries think they are threatened by the countries upstream, and worry about reduced water supply, and the potential implications it will have on them.

Consequently, water security and transboundary river characteristics reinforce the motivation for regional cooperation and integration in the GMS. To exploit the Mekong River in a way that is more equitable for scientific purposes, Mekong countries and other relative organizations established some regional cooperation mechanisms to enforce cooperation (Weatherbee, 1997; Greg Browder, 2000). Although these mechanisms achieved some substantial progress in the subregion cooperation at the Lancang-Mekong basin (Jacobs, 2002; Kelly, 2009), especially in trade and economics (Than, 2005), the functioning of these regional organizations is still far from optimal in terms of water cooperation (Keskinen *et al.*, 2008). They continue to fail in effectively coordinating the differences in the development and utilization of water resources in all riparian countries. Furthermore, there is a lack of a cooperative mechanism in which there is a jointly established and participatory culture among all countries that are willing to work together to meet the current and actual development needs of all countries in the basin. Based on

the practical necessity of the Lancang-Mekong regional cooperation, and the imperfection of the current cooperation mechanism, China has initiated the establishment of the Lancang-Mekong Cooperation (LMC) Mechanism to further strengthen cooperation in water resources under this framework.

2. Background of the establishment of LMC

Water resources are one of the most important resources for countries of the Lancang-Mekong River (Nagumo *et al*., 2013; Erban & Gorelick, 2016). Concurrently, countries in the basin also face many unresolved water resources problems (Orr *et al*., 2012), such as the water resources development and, in particular, the utilization in the transboundary rivers (Sokhem *et al*., 2007; Bhagabati *et al*., 2014). Countries along the Mekong River are in the stage of rapid economic and social development (Walsh, 2013; Sing *et al*., 2016; Bolotov *et al*., 2017). This increases the demands for the development and utilization of water resources. Nevertheless, the demands vary according to the different developmental stages and geographical locations. Laos and Thailand are actively promoting the development of hydropower. Because its demand for electricity is strong (Watcharejyothin & Shrestha, 2009), Lao dams are an infrastructural project for Thailand to help cope with the bottleneck causing its ever impending power shortages. By contrast, Cambodia and Vietnam rely on the Mekong water for farming and fishery (Berg, 2002; Kobayashi *et al*., 2012). They worry that the water resource utilization upstream would disrupt their agricultural production. Thus, they have reservations about the hydropower development of the Mekong (Pearse-Smith, 2012). For example, the Xayaburi Dam and Don Sahong Dam were rejected by Cambodia and Vietnam. This idea would have established a relationship concerning water cooperation between lower Mekong countries and could have helped to ease these strained relationships (Alistair, 2015; Guardian, 2015).

In addition, the Greater Mekong Subregion (GMS) also faces many water security issues. This includes water resources conservation, water ecological environment protection and management of floods and droughts (Yorth, 2014; Chen & Zhu, 2016). This plan operates under the condition of constant global warming and extreme climates (Abiodun *et al*., 2013). As living standards increase in each riparian country, the demand for more energy and more water-intensive food increases quickly. Meanwhile, global climate changes have brought enormous challenges to the sustainable use and management of water resources (Luo *et al*., 2018; Wang *et al*., 2018). In 2011, the Chao Phraya River in Thailand experienced a flood only seen once every 50 years (Preesan Rakwatin *et al*., 2013). In 2015, Myanmar suffered from a once-in-40-year flood (Kawasaki *et al*., 2017). Since late 2015 until the first half of 2016, the Lancang-Mekong basin was hit by drought to various extents due to the influence of El-Nino. The Mekong Delta especially suffered from the worst drought in a century (Hunt, 2016). It is hard to relieve or resolve problems that are caused by an entire basin that relies on a single riparian nation. Thus, watercourse states in the basin must work together effectively to deal with these common problems (Hensengerth, 2009).

Based on these characteristics, a series of bilateral and multilateral cooperation mechanisms and frameworks were established in the GMS. This has promoted water cooperation in the past (Yu, 2003; Lee, 2015). However, the existing cooperation mechanisms have some shortcomings. These are primarily connected with regional water cooperation, especially the transboundary water cooperation. This impasse has affected the improvement of cooperation among the riparian nations, since there is a lack of mutual trust. Furthermore, actual needs remain ignored (Dore, 2006). The Mekong states

must pull together to deal with the challenges of food production, livelihood security and water development. Hence, a highly trusted and practical cooperation mechanism among riparian countries in the basin is now needed.

Thailand was the first country to initiate the sustainable development of the Lancang-Mekong subregion. China proposed the establishment of the LMC Framework at the 17th China-ASEAN Summit. This echoed the first moves made by Thailand. In fact, the geographical location, common demands and challenges constructed a solid foundation for six countries to cooperate. Geographically, six countries were all located along the Lancang-Mekong river and shared common rivers. Meanwhile, they have closed cultural and historical linkages. Nevertheless, they face the common task of developing the economy and improving people's living standards. There are also common challenges, such as the increasing downward trend of the global and regional economy, and nontraditional security threats such as terrorism, natural disasters, climate change and environmental problems.

3. Situation analysis on water resources cooperation mechanisms in the GMS

3.1. Present water resources cooperation mechanisms in the GMS

With deepening globalization and the integration of the regional economy, the cooperation between countries has become deep and frequent. By the beginning of the 1990s, subregional economic cooperation has emerged, and various cooperation mechanisms have been formed in the GMS (Swee-Hock *et al*., 2005; Chheang, 2010; Tan, 2014). Parts of major cooperation mechanisms are shown in Table 1. The main regional cooperation institutions in the GMS are the Greater Mekong Subregion Economic Cooperation Program (GMS Program), ASEAN-Mekong Basin Development Cooperation (AMBDC) and the Mekong River Commission (MRC).

The Asian Development Bank (ADB) is one of three regional development banks in the world. In 1992, it supported the establishment of the GMS Program. The GMS Program includes six riparian nations in the Lancang-Mekong River. It mainly focuses on telecommunications, roads, tourism and other programs to promote the intra-regional linkage. But the GMS Program did not put enough attention on environmental issues, particularly the development of water resources and transboundary watercourse cooperation. This has been the most important and controversial problem.

The Mekong Committee (MC) was established in 1957 and finally evolved into the MRC. This is the most professional and influential water cooperation mechanism. In 1995, with the support of international donor agencies, the lower Mekong countries (Laos, Cambodia, Vietnam and Thailand) established the MRC under the Agreement on Cooperation for the Sustainable Development (Chiang Rai Agreement) of the Mekong River Basin. The MRC has a complex agenda of resource sharing, conservation and development. This makes it the center of controversies over resource-based regional integration, especially dam building, which is the main issue of the basin development and environment politics.

Another important regional cooperation organization is the AMBDC. This was set up by 10 members of the Association of South East Asian Nations (ASEAN) together with China, Japan and Republic of Korea. The AMBDC is one of the cooperative framework areas of ASEAN and focuses on the sustainable development of the Greater Mekong Basin. The AMBDC and ASEAN Integration are inclined to the fields of transportation and energy (Qingzhong, 2011). What is different with the MRC is that the AMBDC emphasizes the geographical characteristics rather than purely the river and natural resources.

Table 1. Parts of Cooperation Mechanisms in GMS.

Cooperation mechanisms	Cooperation fields	Participants	
		Members	Initiators or leaders
Greater Mekong Subregion Economic Cooperation Program (GMS Program)	Energy, Transportation, Environment, Tourism, Economy, Human Resources	China, Laos, Vietnam, Thailand, Myanmar, Cambodia	The ADB
Mekong River Commission (MRC)	Environment, Water resources, Agriculture, Fishery, Shipping	Laos, Vietnam, Thailand, Cambodia, China and Myanmar (observer state)	The USA
ASEAN-Mekong Basin Development Cooperation (AMBDC)	Energy, Transportation, Agriculture, Economy, Tourism, Human Resources, Science & Technology	China, Japan, Republic of Korea + ASEAN	ASEAN
East Asia Summit (EAS)	Energy and Environmental Protection, Finance, Education, Public Health, Disaster Management	ASEAN + China, Japan, Republic of Korea, India, Australia, New Zealand, Russia, USA	ASEAN
ASEAN-China Cooperation	Trade, Investment, Tourism, Education, Culture	10 ASEAN Countries + China	ASEAN-China
ASEAN-Japan Comprehensive Economic Partnership (AJCEP)	Transportation, Environment, Economy	Laos, Vietnam, Thailand, Myanmar, Cambodia, Malaysia, the Philippines, Singapore, Brunei	Japan
Mekong-Japan Cooperation Framework	Economy, Human Resources, Energy	Cambodia, Laos, Myanmar, Thailand, Vietnam	Japan
Lower Mekong Initiative (LMI)	Environment, Human Resources, Science & Technology, Energy	Laos, Vietnam, Thailand, Cambodia, Myanmar	The USA
Mekong-Republic of Korea Foreign Ministers' Meeting	Environment, Human Resources, Science & Technology, Energy	Cambodia, Laos, Myanmar, Thailand, Vietnam	Republic of Korea
Mekong-Ganga Cooperation Initiative (MGCI)	Human Resources, Science & Technology, Tourism, Transportation	Cambodia, Laos, Myanmar, Thailand, Vietnam	India

Besides, there are also other regional cooperation and dialog mechanisms that relate to water issues. The United Nations Economic Commission for Asia and the Far East (ECFAE) was established in 1946. This became the United Nations' Economic and Social Commission for Asia and the Pacific (ESCAP). Its main purpose was to boost regional economic growth. Other mechanisms like the Friends of the Lower Mekong were dominated by the USA and focused on the promotion of democratic reformation and other functional cooperation in the field of environment and climate. The ASEAN-Japan Comprehensive Economic Partnership was dominated by Japan. This had its preference in the official development assistance in the economic fields. The Mekong-Republic of Korea Foreign Ministers' Meeting was dominated by the Republic of Korea and pays attention to the fields of infrastructure, green growth, development of agriculture and rural areas, together with the development of human resources. The Mekong-India cooperation emphasized the fields of tourism, education, culture and transportation.

3.2. Deficiencies of the present water resources cooperation mechanisms in the GMS

These cooperation mechanisms have played an important role in promoting cooperation in the economy, investment, energy, environment and transportation in the GMS (Roughneen, 2010; Urban, 2013). However, most of the cooperation mechanisms, owing to their own institutional defects (Haefner, 2013), have failed to truly and effectively realize the regional water resources cooperation, or meet the actual demands of riparian countries, especially the transboundary development and utilization of water resources. In general, the current cooperation mechanisms in the GMS have the following defects.

First, most current cooperation mechanisms are led by countries outside this region. Among these mechanisms, except the GMS and AMBDC, most are dominated by extra-regional countries. On the one hand, there are conflicts of interest among the leading countries or organizations, as they have different interest demands in this region, and often compete with each other to ensure their own interests (Hirsch *et al*., 2006). The different interests and concerns of these stakeholders lead to competition and a lack of trust within the cooperation mechanisms. This undermines the effectiveness of the actual cooperation in the region.

On the other hand, there are contradictions between the advocacy that environmental protection is the foremost consideration in the developed countries or environment protection organizations, and the demand for social and economic development in the region. The cooperation mechanisms guided by countries outside the region are more geared towards implementing the ideas and intentions of the initiators. They pay less attention to the actual demands in the region. The Mekong River Basin is in a period of rapid social and economic growth. This has an increasing demand for water resources and electricity. Cooperation mechanisms are dominated by the Western developed countries. However, this places too much emphasis on environmental protection. Thus, it ignores the real needs of the countries in the region. In addition, the cooperation mechanisms supported by foreign capital are usually affected and restricted to focusing fields, cooperation modes and project contents (Ha, 2011).

Secondly, the present cooperation mechanisms lack the participation of upstream countries. Thus, they are insufficient in authority and effectiveness. The basin is an integrated part. This needs all countries to participate in order to realize the overall utilization and protection of water resources in the entire basin. At present, there are no water resources cooperation mechanisms that are jointly established by the six countries (Li & Guangsheng, 2016). GMS and MRC are the mechanisms with the most participants and the highest level of cooperation of all existing cooperation mechanisms. However, GMS mainly focuses on the economic and interconnection fields. The lack of attention to the water resources cooperation results in its limited effectiveness in water cooperation. Although MRC focuses on water resources, especially on the development, utilization and protection of transboundary water resources, China and Myanmar have not joined as members, but have only participated in a limited way as observers. This has resulted in a lack of regional recognition and thus undermined the authority and effectiveness of MRC (Mehtonen *et al*., 2008).

The mechanism of water resources cooperation in the basin, without the participation of upstream countries, cannot create a community of common destiny that takes water as the unifying element. Every transboundary river should be regarded as a whole basin. Therefore, in order to achieve the cooperative development, which requires the utilization and protection of the rivers, it is necessary to find an effective platform for cooperation. This will ensure that all stakeholders can negotiate in an open, equal and friendly manner under the commonly recognized cooperative frameworks and mechanisms. Due to the lack of in-depth participation of the upstream countries, various policies

and measures focusing on water ecological environment and safety are currently designed for the protection of the water quality and rare fish of the Mekong in the Lancang-Mekong Basin. However, they are sporadic and stopgap policies. They lack a comprehensiveness and systematic basin management, or a governance framework.

Thirdly, the present cooperation mechanisms generally focus on the economic field and lack the effective cooperation in transboundary water resources. The current cooperation mechanisms in this subregion mainly focus on the fields of economy, trade and transportation, public sanitation, environment protection and other fields. To avoid unnecessary strife, the mechanisms are usually not involved in the field of transboundary water resources, with the exception of the MRC.

The MRC is the most professional existing mechanism for water resources cooperation. It focuses on the development, utilization and protection of water resources in the Mekong basin. However, it is an inter-governmental agency (Hirsch, 2011; Chang, 2013) that lacks binding force or enforcement rights over member countries. In fact, the MRC is more like a discussion and investment introduction institution. Each member always puts the state interests before the basin's common interests. A lack of sufficient trust, power imbalances and narrow national interests hinder the complete cooperation among Mekong countries. Another important reason that hinders the MRC from fulfilling its function is that its simple 'water-based approach' separates water resources cooperation from cooperation in other fields such as politics, economy and security. The MRC, or the initiators of the MRC, does not realize that the dilemma of water resources cooperation must be solved by using a perspective beyond the water itself. Failure to do this would only lead to a zero-sum game.

In summary, the existing regional cooperation mechanisms dominated by Western countries and organizations are not effective enough to coordinate and resolve water disputes. Therefore, it is necessary to establish a transboundary water resource cooperation mechanism that is truly participatory, and one that is led by all countries in the region. This has a certain binding force and meets the actual development needs of all countries.

4. Vision and advances of water resources cooperation of the LMC

4.1. Vision and cooperation areas of the LMC

The LMC is a new type of subregion cooperation mechanism that was established jointly by China, Myanmar, Laos, Cambodia, Thailand and Vietnam in 2016. The shared vision of the LMC is to contribute to the economic and social development of subregional countries, enhance the well-being of six countries' people, narrow the development gap among regional countries, and support ASEAN Community building, together with promoting the implementation of the UN 2030 Agenda for Sustainable Development and advancing the South–South cooperation.

The LMC aims to establish an example of a new type of international relations, where they emphasize the importance of a win–win cooperation. To achieve this goal, a framework featuring leaders' guidance, all-round cooperation and broad participation was conducted. Consequently, a government-guided, multiple-participation and project-oriented cooperation model was built.

According to the *Sanya Declaration of the First LMC Leaders' Meeting*, political and security issues, economic and sustainable development, and social, cultural and people-to-people exchanges are the three cooperation pillars of LMC. Furthermore, as a result of the meeting, it was confirmed that practical

cooperation would start with five key priority areas during the initial stage of the LMC, namely: connectivity; production capacity; cross-border economic cooperation; water resources; agriculture; and poverty reduction.

The framework of the LMC is shown in Figure 2. Under the principle of leaders' guidance, the LMC formed multiple levels of cooperation and consultation mechanisms. The Leaders' Meeting is the highest level. It is responsible for making top-level design and strategic planning. The Foreign Ministers' Meeting and Senior Diplomatic Officials' Meeting are the diplomacy department level. They are responsible for discussing and negotiating the cooperation issues made by the Leader's Meeting. There are five joint working groups, which are organized according to previously established cooperation fields. They are responsible for answering and executing specific programs. Concurrently, six countries have agreed to found the Lancang-Mekong Water Resources Cooperation Center. This is located in China and acts as the comprehensive water resources cooperation platform. It works to strengthen communication and cooperation among six countries' water sectors.

4.2. Advances of Water Resources Cooperation under the LMC

The LMC has become one of most dynamic and potential mechanisms in the GMS. Until now, the LMC has been developing smoothly and achieved some positive results. A series of meetings and

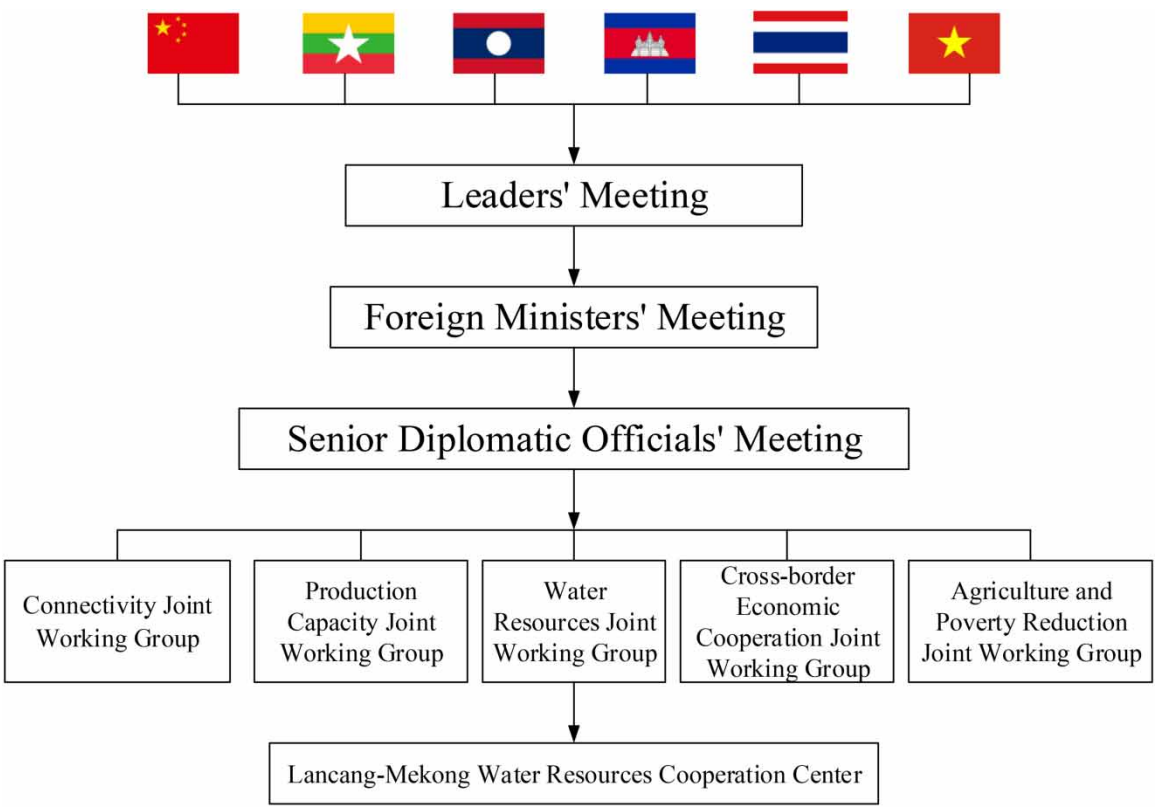


Fig. 2. Water Resources Cooperation framework under the LMC.

dialogs were held between six countries (detailed in Table 2), and a few practical cooperation programs have been carried out in just 3 years. Cooperation frameworks and organizations of the LMC have accomplished numerous cooperative relationships, and the pace of negotiations is moving quickly. This proves that the LMC indeed satisfies the real needs of riparian nations, and is a practical cooperative mechanism for the GMS.

Since the establishment of LMC, member countries have been vigorously promoting the cooperation to be more deeply and extensively. So far, every country has established the LMC National Secretariats. These play a key role in balancing and coordinating between six members. Moreover, in order to facilitate water resources cooperation under the LMC, China has organized the Lancang-Mekong Water Resources Cooperation Center, with a view to create a comprehensive cooperation platform to support the Lancang-Mekong water resources cooperation. Concurrently, China and the other five countries have carried out numerous technical cooperation and exchanges with people, management, information and research. Some programs, such as capacity building on water resources management (by academic programs), training, field trips and study tours; joint assessment of flood control and drought relief in the Mekong basin, in addition to setting up of communication channel for sharing information in emergency case of flood and drought in Lancang-Mekong river, formulating a Five-Year Action Plan on Water Resources Cooperation have been, or are currently being implemented.

Table 2. The main meetings on Water Resources Cooperation of the LMC.

Time	Meeting
2014.11	The 17th China-ASEAN Summit
2015.11	The 1st LMC Foreign Ministers' Meeting
2016.03	The 1st LMC Leaders' Meeting
2016.07	The Director-level Meeting of Joint Working Group on Water Resources Cooperation
2016.12	The 2nd LMC Foreign Ministers' Meeting
2017.02	The 1st Meeting of JWG of Water Resources Cooperation of LMC
2017.12	The 3rd LMC Foreign Ministers' Meeting
2018.01	The 2nd LMC Leaders' Meeting
2018.03	The 2nd Meeting of JWG of Water Resources Cooperation of LMC
2018.03	The 1st Water Resources Cooperation of LMC Week
2018.07	The 1st Special Meeting of JWG on Water Resources of LMC in 2018
2018.10	The 2nd Special Meeting of JWG on Water Resources of LMC in 2018
2018.11	The 1st Lancang-Mekong Water Resources Cooperation Forum
2018.12	The 4th Foreign Ministers' Meeting
2019.03	The 2nd Water Resources Cooperation of LMC Week
2019.04	The 3rd Meeting of JWG of Water Resources Cooperation of LMC
2019.06	The 1st Special Meeting of JWG on Water Resources of LMC in 2019
2019.08	The 2nd Special Meeting of JWG on Water Resources of LMC in 2019
2019.10	The 3rd Special Meeting of JWG on Water Resources of LMC in 2019
2019.12	Ministerial Meeting of Lancang-Mekong Water Resources Cooperation
2020.02	The 5th Foreign Ministers' Meeting
2020.03	The 3rd Water Resources Cooperation of LMC Week
2020.05	Video Meeting of JWG on Water Resources of LMC

5. Comparative advantages and challenges of Water Resources Cooperation under the LMC

5.1. Comparative advantages of water resources cooperation under the LMC

There are some comparative advantages of water resources cooperation under the LMC, compared with the existing water resources cooperation mechanisms in Greater Mekong Subregion, such as High-level cooperation, Wide range of cooperation and Large number of cooperation (detailed in table 3).

5.1.1. High-level cooperation. The LMC is a high-level regional cooperation mechanism guided by state leaders. The Sanya Declaration clearly defined the LMC as a community of common destiny for the Lancang-Mekong countries toward peace and prosperity under the framework guided by state leaders. Compared with the existing cooperation mechanisms in the basin, the Lancang-Mekong water resources cooperation boasts the characteristics and advantages of a high level and high starting point of cooperation. Heads of countries are the guides for this policy. First, the LMC is a new type of high-level regional cooperation that has been established with the proactive guidance and promotion by the heads of the Lancang-Mekong River basin countries. Secondly, there is a high level of cooperation. The LMC has established a high-level structure in multiple levels, including the leaders' meetings, foreign ministers' meetings, senior officials' meetings and working groups' meeting. These are responsible for the top-level design and strategic planning for the long-term development of the LMC mechanism. Thirdly, there is a high starting point for cooperation. Lancang-Mekong countries attach great importance to the LMC and establish coordinating bodies quickly to push forward the LMC process. Consequently, a series of important meetings and dialogs have been successfully held. Moreover, the LMC has stepped rapidly into the substantive cooperation stage and has executed practical projects cooperation under the project-oriented model.

Table 3. The comparative advantages and challenges of the LMC.

Comparative advantages	Comparative challenges
The first new subregional cooperation mechanism jointly created by the six countries in the basin	Low level of economic development and insufficient stability in Indo-china Peninsula
Adjacent geographic conditions	Policy sustainability is facing challenges in Mekong countries
Similar cultural background	The potential impact of historical grievances and territorial disputes
Closely complementary economic and trade relations	Setting up effective cooperation with existing mechanisms
High level of cooperation, leaders of all countries attach great importance	The squeeze from existing cooperation mechanisms and the strategies to deal with this issue
Multilevel and multi-dimensional complex regional cooperation mechanism	
Wide range of cooperation	
The structure of the cooperation system is relatively reasonable	
Establish a multilevel cooperation framework and implementation platform	
Pragmatic, equality, open and inclusive	

5.1.2. Wide range of cooperation. The areas of LMC are all-round and wide. The LMC is a new type of regional cooperation mechanism with the advantages of all-round areas and in-depth comprehensive cooperation. Different from the past cooperation mechanisms in the region, which generally concentrate or focus on individual areas, the LMC conducts an all-round cooperation in three major areas: political security; economy and sustainable development. Additionally, areas such as society and humanity have five priority areas: cooperation in connectivity; production capacity; cross-border economy; water resources; and agriculture and poverty reduction. These receive significant attention. The LMC, with the continuous improvement of the cooperation level, will expand cooperation in the digital economy, environment protection, health, customs, youth and other areas. Thus, a '3 + 5 + X' cooperation framework in the future will be gradually formed. Secondly, through all-round and deep-level comprehensive cooperation, it is more conducive to solve the water resources problems. This is because water resources are closely related to economic, social, environmental and political issues. Therefore, the solutions to the water problems should be considered with integration into the overall system of economy and society, rather than the attempt to simply rely on the 'water-based approach' that will get half the results from double the effort. The LMC breaks the shackles of the past cooperation mechanisms, thus enhancing the level, width and depth of cooperation in the field of water resources. This will yield twice the result with half the effort.

5.1.3. Large number of cooperation. All riparian countries participate in the LMC and thus build a solid cooperation foundation. The LMC is established by a consensus of six Lancang-Mekong countries. It has the participation of all countries in this basin to jointly tackle the economic, social and environmental challenges. This makes the cooperation foundation solid. First, water resources cooperation under the LMC has achieved for the first time the participation by all countries in the Lancang-Mekong basin. This ensures that LMC can truly achieve the cooperation covering the whole basin, avoiding the absence of authority faced by the current cooperation mechanisms. Secondly, water resources cooperation under the LMC is the first co-sponsored mechanism initiated with the consensus reached by six Lancang-Mekong countries. This means that Lancang-Mekong countries finally have their own cooperation mechanism of transboundary water resources. Thus, the various cooperative efforts can be conducted to meet the needs of their actual development. Thirdly, the Lancang-Mekong countries have a common goal and vision. Although all riparian countries are developing countries with different national conditions, they are commonly tasked with developing an economy and improving people's livelihoods. Concurrently, the Lancang-Mekong countries are also facing the increased downward pressure from the global and regional economy, as well as common challenges brought by terrorism, natural disasters, climate change, environmental issues, infectious diseases and other nontraditional security threats. Therefore, six countries have the unanimous goal and vision of cooperation. This includes promoting economic and social development, advancing the well-being of basin residents and narrowing the development gap among the countries in the region. The features mentioned above for the LMC make it a more equal, cohesive and solid regional cooperation mechanism.

5.2. Challenges of water resources cooperation under the LMC

As a new type of regional cooperation mechanism, the LMC faces some challenges on the road of development. However, it has its own advantages. First, it is a challenge for the LMC in terms of

how to coordinate and cooperate with the existing regional cooperation mechanisms. As previously described, various subregional cooperation mechanisms participated by multiparty and existed simultaneously in the GMS. The water resources cooperation under the LMC would inevitably overlap with other cooperation mechanisms in fields, functions and programs. Secondly, how truly mutual trust in the cooperation of transboundary water resources in the Lancang-Mekong River could be established is another challenge. Whether or not the international cooperation works well would depend on the coordination of national interests and international trust. The LMC must ease the fundamental contradiction between national interests and international trust in the cooperation of transboundary water resources and establish a common awareness to maintain the water resources community. Achieving this goal requires forming a related obligatory system arrangement. This means six countries must transfer parts of their sovereignty in this area. This is difficult for any country to concede any element of their power. Thirdly, the LMC faces financing problems that other cooperation mechanisms have also faced in this region. The GMS is a less developed region. Myanmar and Laos belong to the poorest countries in the world. China is the main provider of capital and technology in water resources under the LMC. The Chinese government has provided, and will continue to provide, significant funds. However, it is obviously neither sustainable nor scientific for one nation to afford the funds forever. Therefore, the LMC needs to find a way to resolve this challenge, since this has not been solved by others.

6. Conclusion

The LMC was a new type of subregional cooperation mechanism, featuring common contribution and shared benefits. It was built following the development trend of the times. It satisfied the actual need of six countries in the GMS. The Water Resources Cooperation of LMC is a new but rapidly growing regional cooperation mechanism. This is also an open and inclusive system. The Water Resources Cooperation of LMC provides a new cooperative road. More choices are available for countries in the GMS. For the last 3 years, substantive progress has been made in the institution building, including early cooperation on projects and funds supporting water resources cooperation under the LMC. The LMC has finished the cultivation period and has entered a faster growth period.

To make the LMC work better, and further strengthen water resources cooperation under the LMC, some improvements could be carried out. This would include strengthening coordination and communication between the water resources jointly working as a group, and the formation of other working groups. This would serve to take advantage of all-round and wide cooperation, and thus avoid conflicts. Concurrently, a special fund for the water resources cooperation field under the LMC as a way to guarantee the capital supply could be established. This would serve to enhance the construction of water think tanks specializing in water resources development and utilize the need for professional guidance and assistance.

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Conflict of interest

No potential conflict of interest was reported by the authors.

Data availability statement

All relevant data are available from an online repository or repositories. The most used URLs include: https://www.mrcmekong.org/; http://cn.lmcwater.org.cn/; http://www.chinaaseanenv.org/lmzx/; https://iwa-network.org/.

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