Analysis on the Transboundary Impact Assessment System and Practice of Hydropower Development on the Main Mekong River

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Abstract: The relevant documents and regulations on procedures and contents of transboundary impact assessment issued by the Mekong River Commission are combed. Combining with analysis of existing practice, experience and shortcomings of transboundary impact assessment in hydropower development on the main Mekong River is discussed. The results show that the transboundary impact assessment procedure of the Mekong River Commission is gradually improving. What’s more, the management mode of transboundary impact has gradually changed from paying attention to the prior evaluation to the whole process management. But there is no universal assessment standard for the transboundary impact, and the comprehensive assessment of the transboundary impact caused by hydropower development is lacked.

1.Introduction
Lancang-Mekong River flows through China, Laos, Myanmar, Thailand, Cambodia and Vietnam, which is the most important transnational water system in Asia. It is called Lancang River in China and Mekong River after leaving China. In recent years, the Mekong countries are facing the urgent task of accelerating economic development, and pay more attention to the development and protection of water resources. However, due to the particularity of the transboundary river water resources shared by all countries, the development of river basin water resources is often not simply an internal problem of a country, but an international problem involving multi-national, multi actor participation and multi interest demands. In particular, the hydropower development projects on main stream in transboundary basins are often interfered, questioned or opposed by other countries in the basin due to their transboundary impact, which has aroused great attention of all countries in the basin. In order to promote the rational and orderly development of water resources in the Mekong River Basin, as the only intergovernmental organization engaged in the development and management of water resources in the Mekong River basin, the Mekong River Commission (MRC) signed Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin (1995 Mekong Agreement) as early as 1995, and gradually issued relevant provisions on transboundary environmental impact
assessment, such as *Procedures for Notification, Prior Consultation and Agreement (PNPCA)* and *Guidelines for Transboundary Environmental Impact Assessment in the Lower Mekong Basin (TbEIA Guidelines)* have played an important role in guiding the development and utilization of water resources in the Mekong River countries. However, there are still many problems in practice due to different interests of different countries.

With the rapid development of water resources in the Lancang-Mekong basin, the conflicts and differences between MRC Member States and other stakeholders caused by transboundary environmental impact issues have become more and more prominent. The transboundary environmental impact issues of hydropower development in the Lancang-Mekong basin have gradually become the object of widespread concern of domestic and international scholars. Daming HE et al. [1] and Ying GU et al. [2] comprehensively analyzed the transboundary hydrological effect of hydropower development on the main stream of Lancang River; Yong ZHANG et al. [3] studied the impact of dam construction on the resettlement of upper Mekong River; Lihui CHEN and Daming HE [4] proposed countermeasures to meet the needs of the countries in the basin in energy, flood control, irrigation, water ecological protection and reducing seawater backflow; The transboundary influence of hydropower development and other water use projects on the downstream of Lancang Mekong River is analyzed by Chinarong and Pianporn [5]. Yang KUANG et al. [6] analyzed the PNPCA mechanism and put forward suggestions for improvement, Zhanwen QUE [7] discussed the obligation and performance of transboundary environmental impact assessment, and Lingjie KONG [8] studied the environmental impact assessment in the development of transboundary water resources from the perspective of international law.

To sum up, although many scholars from home and abroad have studied the environmental impact of hydropower development in the Lancang-Mekong basin from many aspects, there is still a lack of in-depth study on the transboundary impact assessment of hydropower development in international rivers. Nowadays, with the continuous progress of hydropower construction on the main Mekong River, the transboundary impact assessment and mitigation of hydropower development in transboundary basins has become an urgent need for Mekong countries. This paper systematically reviews the relevant regulations on transboundary impact assessment (*PNPCA Regulations, TbEIA Guidelines, Preliminary Design Guidance for Proposed Mainstream Dams in the Lower Mekong Basin (PDG) and The MRC Hydropower Mitigation Guidelines*) issued by MRC. Based on the practice of six hydropower stations built and under construction on the main Mekong River, this paper analyzes the problems existing in the environmental impact assessment of hydropower development on the main Mekong River, and discusses the relevant provisions of MRC and its effectiveness and shortcomings in practice. This study is to explore the way out for the sustainable development of hydropower in the basin, which can provide a reference for the coordination and mitigation of transnational water related conflicts of interest.

### 2. Relevant transboundary environmental impact assessment regulations of MRC

#### 2.1. Analysis of cross border impact assessment procedure

In order to optimize the development and utilization of water resources, reduce adverse transboundary impacts, and guide member states to perform the obligation of prior consultation on the development and utilization of trunk water resources [6], on November 30, 2003, MRC formulated the relevant procedural specification, namely *PNPCA Regulations*, which specifies the basic principles, management institutions and operation process of prior consultation among Mekong countries. The regulation provides consultation and communication guidelines for Mekong countries to develop and utilize water resources in the Mekong River basin, and plays a certain role in coordinating water related disputes among countries. However, there are some defects in the system design of the regulation, such as the time frame of prior consultation, the submission of materials, the depth of environmental impact assessment and other matters are relatively principled and vague, and the operability is not strong, and there are no further provisions on transboundary impact issues, so there
are various conflicts and contradictions in the practice of hydropower development. Therefore, in order to further support and strengthen the effective implementation of PNPCA Regulations and promote cooperation in environmental impact assessment of projects with potential transboundary impacts, MRC issued TbEIA Guidelines on September 25, 2018. According to TbEIA Guidelines, early consultation should be carried out before determining the scope of transboundary assessment and preparing EIA report, so as to consider and meet the demands of all Member States as much as possible in EIA, which can greatly improve the efficiency of prior consultation; the organic integration of transboundary impact assessment and prior consultation process makes it clear that transboundary impact assessment should be paid attention to in the process of prior consultation; at the same time, the supervision mechanism has been improved to urge and force the project sponsors to fulfill their commitments and protect the relevant interests of potential affected countries.

It can be said that from PNPCA Regulations to TbEIA Guidelines, with the development of Mekong hydropower, MRC pays more and more attention to the transboundary impact of water resources development, and constantly improves the guidelines for impact assessment.

2.2. Analysis of cross border impact assessment

According to the relevant documents published on the official website of MRC (PNPCA Regulations, TbEIA Guidelines, PDG, The MRC Hydropower Mitigation Guidelines). The content of transboundary impact assessment can be divided into evaluation indicators, evaluation standard and mitigation measures.

In terms of evaluation indicators, TbEIA Guidelines provides an indicative list of potential transboundary impacts of hydropower projects. Direct impacts and indirect impacts are considered respectively in the design stage, construction stage and operation stage of the project. The main indicators include hydrology, aquatic animals, aquatic habitat, terrestrial ecology, people's livelihood, immigration, economy, tourism, etc., which can provide reference for transboundary impact assessment.

In terms of evaluation methods and standards, TbEIA Guidelines put forward two evaluation methods of "possibility" and "degree", which are used to determine the "low", "medium", "significant" or "very significant" levels of transboundary impacts. Meanwhile, it emphasizes that full consultation should be conducted in practice and the opinions of Member States should be fully considered. In terms of evaluation criteria, there is no unified standard for specific transboundary impact evaluation indicators to determine the degree of transboundary impact, which is often evaluated by the project sponsor country mainly based on its own relevant laws and regulations.

In terms of mitigation measures, MRC issued PDG on August 31, 2009, which contains the preliminary guidance on the design and operation principles of mitigation measures, mainly involving key areas such as hydrology, sediment, water quality, fishery, shipping and dam safety. What's more, the PDG is being continuously updated [9]. In addition, The MRC Hydropower Mitigation Guidelines published in 2019 introduced application of regional and global excellent cases in hydropower impact mitigation in Mekong River basin, providing better strategic and technical guidance for transboundary impact mitigation measures of power stations.

It can be seen that the existing relevant documents issued by MRC provide some guidance from the indicators, methods and mitigation of transboundary impact assessment. In the aspect of evaluation index, comprehensive consideration is given to the impact of natural environment and social environment, and preliminary transboundary impact evaluation index is given for reference; in the aspect of evaluation method, only relatively shallow evaluation dimension and grade are given, emphasizing that full consultation among all parties is still needed; in the aspect of evaluation standard, there is no unified standard, which is a challenge for the practical cooperation among the countries in the basin on transboundary impact assessment, and this aspect will become one of the important directions of the joint efforts of all countries in the river basin in the future. In the aspect of mitigation measures for transboundary impacts, technical guidance on engineering design and impact mitigation has been initially provided from the "prior" perspective, however, there is a lack of specific mitigation
measures for "after the event" adverse effects, which needs further discussion between the interested parties affected by the project.

3. Practical analysis of cross border impact assessment based on typical projects

At present, among the 11 planned hydropower stations on the main Mekong River, the Xayaburi and the Don Sahong hydropower project have been completed. The prior consultation procedure of the Pak Beng, the Pak Lay and the LuangPrabang hydropower project have completed, and the Sanakham hydropower project has entered the prior consultation procedure. All six hydropower stations are located in Laos. According to the information on MRC website[10], The relevant transboundary impact assessment regulations issued by MRC since 1995 and the time axis of the development process of the hydropower station on the main Mekong River are summarized, as shown in Figure 1.

![Figure 1. Relevant regulations of the MRC on transboundary impact assessment and hydropower development process on the main Mekong River.](image)

During the development process of Xayaburi hydropower station and Don Sahong hydropower station, they have aroused concerns and opposition from Cambodia, Thailand and Vietnam. All stakeholders believe that "the existing relevant research and data in Laos are insufficient", and require "to evaluate the environmental and social transboundary impact of downstream areas". Neither of the two projects has reached an agreement in the prior consultation process and put forward suggestions to the MRC Council. Among them, in the prior consultation of Xayaburi hydropower station, Laos and the developer responded to the requirements of interested countries by increasing investment, modifying the dam design and improving the fish passage [11]. However, the Dong Sahong hydropower project was still unable to reach a consensus at the MRC Council level, and the dispute was submitted to the member governments to seek a solution through diplomatic channels. Finally, the construction
was still started in October 2015. It can be seen that the PNPCA Regulations, to a certain extent, has played a role in urging the project sponsor to pay attention to the transboundary impact of the proposed project and the negotiation and communication with other potentially affected countries, but it does not have mandatory binding effect on the project sponsor, so it lacks effectiveness in practice.

At present, Pak Beng hydropower station has completed the prior consultation process in accordance with the requirements of PNPCA Regulations; after the TbELA Guidelines and The MRC Hydropower Mitigation Guidelines are released in succession from 2018 to 2019, three hydropower stations (Pak Lay, LuangPrabang and Sanakham) have entered the prior consultation process one after another. In the prior consultation of the three hydropower stations named Pak Beng, Pak Lay and LuangPrabang, Cambodia, Thailand and Vietnam still requested to further evaluate the transboundary impacts in terms of environment, social economy and other aspects and formulate effective mitigation measures. However, in the final consultation process, all Member States agreed to build the proposed project and Joint Action Plans (JAP) for Pak Beng and Pak Lay hydropower projects approved [12] to strengthen existing measures to mitigate potential transboundary impacts and promote communication among Member States. In addition, in the prior consultation of LuangPrabang hydropower station in June 2020, Vietnam appreciated the practices of MRC and Laos, saying that they have made progress in supplementary documents, data and information, as well as in the assessment methods of cumulative impact and transboundary impact [13]. On February 24, 2020, the downstream countries of the Mekong River officially launched the pilot project of monitoring the transboundary environmental impact of Xayaburi and Dong Sahong hydropower stations [14]. The joint environmental monitoring pilot program (JEM) of hydropower projects on the main Mekong River is a response to the standard operating procedures for joint environmental monitoring of hydropower projects on the main Mekong River, which systematically collects and generates water through standardized Basin wide joint environmental monitoring and share reliable scientific data and information in the river basin, so as to propose solutions to deal with the possible adverse effects of existing and planned power stations on the main stream of the Mekong River. It can be seen that with the accumulation of practical experience and the gradual improvement of MRC related provisions, the Mekong countries pay more attention to the transboundary impact assessment in the hydropower development on the main Mekong River, and the relevant technology has been improved. The whole process management of transboundary impact from the design stage to the operation stage is gradually realized through the mode of "prior consultation, in-process optimization and post monitoring". In addition, it can be seen from Figure 1 that in recent years, the development process of hydropower stations on the main Mekong River has gradually accelerated. For example, there is a gap of about 20 months between the completion of the prior consultation of Pak Beng hydropower station and the start of the prior consultation of Pak Lay hydropower station, while there is a gap of only one month between the completion of the prior consultation of LuangPrabang hydropower station and the start of the prior consultation of Sanakham hydropower station. This also reflects that the implementation efficiency of the prior consultation procedure for hydropower development on the main Mekong River has been greatly improved after it has been closely integrated with the transboundary impact assessment, and has basically become a set of practical operation mode.

However, in the prior consultation of hydropower projects on the main Mekong River, the member states continue to put forward opinions on in-depth assessment of transboundary impacts on environment, social economy, etc., cumulative impact assessment, formulation of mitigation measures, etc., which shows that there are still many deficiencies in transboundary impact assessment, and with the increasingly prominent environmental problems and the need for sustainable development, the member states are also paying attention to transboundary impacts. Impact assessment puts forward higher requirements. In addition, the interest demands of the public in various countries, which are also important stakeholders, should also be valued and guaranteed. In recent years, various civil society organizations and non-governmental organizations cooperate with each other, carry out research and create public opinion, exerting strong pressure on the government to implement hydropower development plan [6]. For example, in the development of the Xayaburi hydropower
station, the public of the communities along the Mekong River in Thailand opposed it, and sent community representatives to file a lawsuit with the Thai administrative court in 2012, questioning Thailand's plan to buy electricity from the Xayaburi dam [15]. The Sanakham hydropower station which is under negotiation in advance, has also aroused strong dissatisfaction from Thai non-governmental organizations and local communities, and even put pressure on MRC to relocate the dam and ask Thailand to refuse to buy the electricity it produces, thus reducing the economic feasibility of the project [16].

Therefore, in the future, it is still necessary to strengthen the research on transboundary impact assessment, improve the level of transboundary impact assessment and supervision of existing and under construction power stations, and provide experience and reference for the development of other power stations on the main Mekong River in the future, so as to promote the friendly cooperation among countries and the sustainable development of the basin.

4. Current achievements and shortcomings

Through the analysis of the relevant transboundary environmental impact assessment regulations issued by MRC and the practice of typical projects, the existing achievements and shortcomings are obtained as follows:

4.1 Achievements

4.1.1 Transboundary impact assessment procedure has formed a set of practical operation mode and has been continuously improved

In the existing practice of prior consultation, it basically abides by the procedural provisions of PNPCA Procedures. TbEIA Guidelines organically combine the transboundary impact assessment and prior consultation procedures, so as to urge the project sponsors to pay attention to the transboundary impact of the proposed project and carry out a comprehensive and scientific evaluation. The efficiency of prior consultation has gradually improved, and a set of practical operation mode has been formed, which can provide reference for the follow-up similar practice.

4.1.2 From focusing on prior evaluation to focusing on the whole process of transboundary impact management gradually change

In the prior consultation of Xayaburi hydropower station and Dong Sahong hydropower station, Thailand, Cambodia and Vietnam all opposed the construction of the proposed project because of the transboundary impact and its evaluation. In the prior consultation of Pak Beng hydropower station, Pak Lay hydropower station and LuangPrabang hydropower station, although countries still put forward the requirements for further evaluation of the transboundary impact, they all reached a consensus and signed the corresponding JAP, which embodies the concept of dynamic control and whole process management.

4.2 Deficiencies

4.2.1 Lack of universal transboundary impact assessment criteria

As for the criteria of transboundary impact assessment, TbEIA Guidelines only gives suggestions on three main factors: scale, location and impact, but does not give universally accepted and unified criteria for quantitative assessment of transboundary impact. However, in fact, there are some differences in the basis of EIA among different stakeholders, and the specific evaluation indicators, evaluation methods and evaluation standards are also quite different, which may make it difficult for the results of transboundary EIA to be recognized by all relevant countries. This has also become an important issue and challenge for countries in transboundary river basins to study in depth.
4.2.2. There is no comprehensive evaluation system that fully considers the transboundary impact

Although MRC has provided corresponding reference for the evaluation indicators and standards of transboundary impacts in *TheIA Guidelines*, the scope of evaluation only includes the possible environmental and social impacts of the project, which is still at the technical level and fails to provide a set of universal comprehensive evaluation index system and quantitative standards to comprehensively reflect the adverse transboundary impacts and overall economic benefits of hydropower projects. Therefore, in practice, the evaluation perspective of transboundary impact assessment is still one-sided, lacking the overall evaluation of the comprehensive factors of the proposed project from an international perspective.

4.2.3. The public participation system of transboundary impact needs to be further improved

Public participation is not clearly defined in *PNPCA Regulations*, and relevant supplements are not made until *TheIA Guidelines* are published, making the issue of public participation has been reflected in the prior consultation process. However, there are still many problems in practice. The public is involved in a wide range, and as a non-governmental actor, the opportunity to really participate in the development and management of water resources in the basin is relatively limited, so it is difficult to meet the interests of all parties; at the same time, because most people do not have the relevant professional knowledge, they can not correctly and comprehensively understand the advantages and disadvantages of water and electricity project development, and their opinions are easily misled and influenced by other factors. Therefore, MRC and its member governments should strengthen the publicity of relevant knowledge and actively guide public participation, shape their correct value judgment, which is very important for reaching understanding and forming positive interaction with them [6], optimize the channels and scope of information disclosure, further improve the system of public participation, so as to ensure the collection and feedback of public opinions, and promote and improve the transboundary impact assessment system of hydropower development.

5. Conclusions and suggestions

A number of relevant regulations on transboundary impact and its evaluation have been issued by MRC, which have been continuously improved and developed, supplemented and refined in practice. A set of operation mode has been formed, and the dynamic control and whole process management of transboundary impact have been gradually paid attention to. The project sponsor countries have made some progress in submitting project basic data and evaluating transboundary impact in the implementation of PNPCA Procedures, accelerate the development process and sustainable development of hydropower projects on the main Mekong River. However, the *PNPCA Regulations* and other relevant provisions do not have mandatory binding force on the member states. The advance of the prior consultation process needs the support of mutual trust, friendly cooperation and conscientious implementation of the *PNPCA Regulations* among MRC member states.

In view of the problems existing in the transboundary impact assessment of hydropower development on the main Mekong River, it is particularly important to formulate the transboundary impact assessment standards generally accepted by all countries in the basin, and further standardize the operation process of transboundary impact assessment, which can enhance the common understanding of the comprehensive impact and benefits of the project among member countries to a certain extent. MRC should further summarize the experience and fully recognize the shortcomings of the existing practice, further standardize and improve the procedures and contents of the transboundary impact assessment of hydropower development on the main Mekong River, establish and improve a complete management mode of the whole process of transboundary impact, so as to provide more efficient guidance and management for the future hydropower development on the main Mekong River.

The countries in the Lancang-Mekong River Basin have a narrow strip of water in the region. In recent years, they have carried out a lot of cooperation under the Lancang-Mekong cooperation mechanism. The environmental cooperation is paid attention to by the countries in the river basin.
Among them, it is particularly urgent and important to establish the collaborative mechanism of environmental impact assessment for the development and utilization of water resources and related infrastructure construction in the river basin. In the future, MRC Member States, China and Myanmar should make full use of the Lancang-Mekong cooperation mechanism to make joint efforts to promote the sustainable development of the basin.

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