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ARTIFICIAL INTELLIGENCE (AI)-DRIVEN SOLUTIONS FOR WATER MANAGEMENT IN THE MEKONG: A PATHWAY TO REGIONAL COOPERATION

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ABSTRACT

The Mekong River is strategically important to its riparian countries (China, Myanmar, Lao PDR, Thailand, Cambodia and Vietnam) but facing critical challenges such as climate change, population growth, land use changes, dam construction and other industrial activities. Regional cooperation mechanisms have been established to deal with such challenges and seek cooperation opportunities and promote policies for future sustainable development of the Mekong communities. Nevertheless, sustainable water management has not been resolved. Concurrently, all the countries in the world are integrating Artificial Intelligence (AI) in all fields. Mekong countries are not an exception. By secondary research with peer-reviewed articles, government and industry reports and media articles, this paper explores the current applications of AI in water management in various parts of the world and in the Mekong region. The paper concludes that AI is potentially applied in the Mekong but has been researched and implemented separately by riparian countries, therefore lacking data availability and quality and algorithm building. In addition, several challenges such as technical expertise, financial constraints, infrastructure limitations, domestic policies, regional cooperation and inter-state coordination, AI has not efficiently worked in the Mekong. This paper recommends a unified AI-driven water management framework delivered by regional cooperation channels to promote AI integration for sustainable development of the Mekong River.

KEY-WORDS: Artificial Intelligence (AI), Mekong River, water management, regional cooperation, sustainable development,

1. Introduction

The Mekong River (about 2,700 miles long) is the longest river in Southeast Asia, running across 6 countries including China, Myanmar, Thailand, Laos, Cambodia and Vietnam. The Mekong is divided into two main parts: the Upper Mekong River Basin and the Lower Mekong River Basin. The Upper Basin includes the Tibetan Plateau, the Three Rivers Area, and the Lancang Basin, which span parts of China and Myanmar. In contrast, the Lower Mekong River Basin encompasses the Northern Highlands (Myanmar and Thailand), the Khorat Plateau (Thailand and Laos), the Tonle Sap Basin (Cambodia), and the Mekong Delta (Vietnam) (Cooley et al., 2009).

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The Mekong plays a vital importance to all the riparian countries in terms of local livelihoods, commercial navigation, economic development and its biodiversity and ecological systems. About 60 to 70 million people economically depend on the Mekong (directly or indirectly) for their source of income and sustenance. The Mekong is source of water for hydropower dams, agriculture, fisheries, and transportation but riparian countries are exploiting the rive differently (World Bank Group, n.d.). Hydropower in the Upper Mekong countries contributed to an estimated revenue of 4 billion USD per year in China alone (MRC, n.d) and about 632 billion USD across all riparian countries while fisheries and agriculture in 2015 account for 17 billion USD and 7.7 billion USD respectively, according to the World Bank.

Yet, Mekong countries do not take advantage of the Mekong in the same way. Upstream nations (China, Myanmar and Laos) prioritize dam construction for hydropower projects (such as the Nuozhadu and Xiaowan dams in China). Meanwhile, the Lower Mekong Basin, including Thailand, Laos, Cambodia, and Vietnam, relies heavily on water resources for agriculture, fisheries and local livelihoods. The contradiction of national interests makes it difficult to manage water resources of the Mekong River to ensure the sustainability of all livelihoods.

In addition, the Great Mekong region faces significant challenges such as climate change, population growth, land use changes, dam construction and other industrial activities such as water scarcity, water pollution and floods, threatening human lives and biodiversity in such areas. These challenges necessitate innovative solutions to ensure sustainable water management.

Since the 1990s, regional cooperation in the Mekong River Basin has evolved significantly due to its strategic location and growth potential. Initially, cooperation was limited to riparian countries, but from the 2000s onwards, it expanded to include major powers and development partners like the U.S., China, Japan, India, and the EU (To Minh Thu & Le Dinh Tinh, 2019). Le Hai Binh (2018) categorizes Mekong cooperation into two main groups:

- ***Intra-regional mechanisms*** with partners among Mekong riparian countries (e.g., Cambodia - Laos - Vietnam development triangle (CLV), the CLMV with additional participation of Myanmar, The Ayeyarwady - Chao Phraya - Mekong Economic Strategy (ACMECS), The Mekong River Commission (MRC), The Greater Mekong Subregion (GMS), the Lancang-Mekong Cooperation (LMC) and ASEAN - Mekong Basin Development Cooperation (AMBDC).
- ***International mechanisms*** with external partners outside the region (e.g., the Mekong-Ganga Cooperation- MGC (2000), Mekong-Japan Cooperation- MJC (2007), the U.S.'s Lower Mekong Initiative- LMI (2009), the Mekong-Republic of Korea - Mekong-RoK (2011) and so on (MOFA of Cambodia, 2024).

the management of water resources in the Mekong River Basin highlights the varying national interests and the significant impact upstream activities can have on downstream countries' economies and livelihoods while dealing with sustainable development challenges across the River.

These frameworks have diversified over the years, involving multiple stakeholders, and addressing various goals beyond transboundary water management, such as economic development and regional connectivity. This growing interest has made regional cooperation in the Mekong Basin complex and dynamic (To Minh Thu & Le Dinh Tinh, 2019). Among them, MRC, GMS and LMC are the most prominent mechanisms. However, sometimes they fell into deadlocks, including the geopolitical competition among major powers such as the US, China, Japan and EU, diverse interests between the upstream and downstream riparian countries, institutional overlap between the MRC, GMS and LMC mechanisms that could lead to the redundancy and efficiency, MRC membership disparities, environmental and water management challenges. These challenges raise many questions for the long-term success, effectiveness and substantiality of such mechanisms. Above all, the aim of cooperation mechanisms is to ensure water resources development to support economic growth, water, food and energy security in the region. Water management must balance national economic interests to all stakeholders to have their agreements, therefore require a new cooperation approach. Will AI be a feasible tool for future cooperation?

Artificial Intelligence (AI) has emerged as a transformative technology with the potential to address complex water management issues (Al Alahmed & Banahsawi, 2024). AI applications, such as machine learning, predictive analytics, and neural networks, offer advanced capabilities for monitoring, predicting, and optimizing water resources. These AI technologies can enhance decision-making processes, improve efficiency, and promote sustainable practices. Despite the promising potential of AI, its adoption in water management across the Mekong countries is still in its early stages. There is a need for a comprehensive analysis of current AI applications that have been applied on a global scale and in Mekong particularly, and their effectiveness in addressing water management challenges. Furthermore, fostering cooperation among Mekong countries can facilitate the sharing of knowledge, resources, and best practices, leading to more effective, practical, and coordinated efforts while satisfying the economic demands of those Mekong countries.

This paper aims to explore the current state of AI applications in water management in the world and within the Great Mekong region. By identifying gaps between them and analyzing existing implementations of AI in water management in the Mekong and its outcomes and challenges, the study seeks opportunities for enhancing regional cooperation mechanisms and leveraging AI technologies to achieve sustainable water management in the Mekong. This research will contribute to the development of a new cooperation mechanism that can support the Mekong countries in their quest for sustainable water resource management.

2. AI transformation in the region

As Industry 4.0 is the prevailing trend of the world, the integration of AI into Mekong regional cooperation mechanisms has gained attention. Riparian countries are very dynamic with digital transformation and AI development in the region though their capabilities vary significantly.

China, as an AI dominant of the world, is investing heavily in research and development, and integrating AI across various sectors, including healthcare, transportation, and agriculture.

China's Belt and Road Initiative also emphasizes AI collaboration with Mekong countries and delivered the Global AI Governance initiative, emphasizing China's role in AI development and security and cooperation with other countries in AI (China's Embassy in Grenada, 2023; MOFA of China, 2024). With robust infrastructure, a large pool of AI talent, and significant government support, China is well-positioned to drive AI innovation and influence in the region.

Thailand and Vietnam are emerging as regional AI hubs. The Thai government approved the Thailand National AI strategy and Action Plan (2022-2027) to promote AI development and application to intensify economic growth and quality of life (NECTEC, 2022). Therefore, Thailand supports AI startups and research through various initiatives. For example, "Thailand 4.0" initiative aims to integrate AI into various sectors, including healthcare and agriculture, to boost economic competitiveness (East Asia Forum, 2024). Thailand's well-developed digital infrastructure and active tech community contribute to its growing AI capabilities. Meanwhile, Vietnam is rapidly advancing in AI, focusing on smart cities, healthcare, and agriculture. The government has launched national strategies to foster AI innovation and aims to become a leading AI hub in Southeast Asia (Vietnam's Government News, 2021). Vietnam's growing tech industry and increasing investments in AI research and startups highlight its strong capabilities and ambitions in this field. Vietnam's government is developing the legal and ethical framework to ensure responsible AI development in Vietnam (Vietnam Plus News, 2024).

Laos, Myanmar, and Cambodia are at the early stages of AI development, therefore face more significant challenges due to limited technological infrastructure and lower levels of investment. However, these countries recognize AI's potential to address developmental issues. For instance, AI can enhance agricultural productivity and improve disaster management (ISEAS, 2024). Therefore, international collaborations and investments are crucial for these nations to build their AI capabilities.

The potential of AI applications in water management in the Mekong is undeniable. However, it is necessary to review what AI can do and how it can be implemented in water management. The following part analyzes the current state of AI application and implementation in water management in various places in the world.

3. AI applications in water management in the world

Water management, according to the US' National Water Management Center (NWMC) (2024), is "the activity of planning, developing, distributing and managing the use of water resources to minimize damage to life and property and to maximize efficient beneficial use. Water management encompasses various activities". In this writing, we divide water management into two major categories, including water resource management such as forecast water demand and supply for efficient reservoir management and optimize the use of water, managing water replenishment, water quality control and wastewater treatment and disaster preparedness, particularly in flood prevention and management to minimize catastrophic consequences.

As water management requires various sources of data with complex calculation for data integration and analysis, traditional methods of collecting data for water management are often manual, time-consuming and prone to human errors (Al Ahlamed & Bahnasawi, 2024).

Meanwhile, AI, mainly with Internet of Things (IoT) and Deep Learning programs (Krishnan, S.R. et al, 2022), has allowed qualified data integration and high accuracy in data processing, aiming at addressing complex challenges. Therefore, powering AI in the water management sector is bringing about efficient and substantial outcomes, making great impacts on water dependent lives.

In water resource management, AI has shifted the way human beings deal with water supply and resource management, for example, AI is applied in reservoir management and accurate water demand and supply forecast for water utilities and prevent droughts and floods, efficient detection of leaks in drainage system to minimize water waste, or analyzing soil moisture and plants to optimize irrigation and nutrigation in agricultural fields (Chang, Chang & Chen, 2023). In addition, water quality control and wastewater treatment are critical issues in agricultural works and urban water management that AI is dealing with, ensuring safe water utilities. While water scarcity is one of the key challenges in water management, these advancements are promoting sustainable water utilities as they not only optimize the efficiency of water usage but also contribute to sustainable water management by minimizing waste or water usage surplus. In addition, it helps reduce time consumption of manual work and labor force.

In disaster prevention and preparedness, AI systems can analyze vast amounts of data from sensors, weather forecasts, and historical records to enhance water supply forecasts and flood prediction. More importantly, when applying AI in dam operations and management, such as reservoir management, structural health monitoring and flood control systems, AI proved the accuracy and efficiency in reducing the risks of dam failures, therefore preventing the catastrophic consequences for downstream residences.

Despite its early stages, AI has been widely applied in water management in different places in the world. Many of them continue to be researched and improved but it is not neglectable that AI is playing its critical role in enhancing its accuracy and efficiency while resolving major challenges such as water scarcity and disaster prevention. The Table 2 introduces AI innovative solutions to longstanding challenges in water management in various regions of the world. In summary, AI is critical to address major issues in water management, including (i) water resources management and (ii) disaster preparedness, but when categorizing by AI power, it can be divided into six function groups, including:

- **Data Integration**: AI can integrate data from various sources like remote sensing, satellite imagery, and GIS to provide comprehensive insights for both data storage for future analysis and real-time decision-making (e.g. aiWATERS)
- **Efficient Water Resource Management:** AI can optimize the allocation and use of water resources, particularly water budgeting and water quality control, ensuring sustainable usage and reducing wastage (such as Baidu's water reservoir management, E-rewater, SIWA leak finder or GRU)
- **Enhanced Forecasting**: AI can improve the accuracy of hydrological and meteorological forecasts, helping to predict floods, droughts, and other water-related events (such as Water Intelligent)

- **Real-time Monitoring**: AI-powered systems can provide real-time monitoring of water quality, reservoir levels, and river flows, enabling timely interventions (e.g. Baidu's application).
- **Impact Assessment**: AI can assess the impacts of upstream dam constructions on downstream water flows, helping to mitigate adverse effects on downstream residents and livelihoods (e.g. Explainable AI)
- **Early Warning Systems**: AI can enhance early warning systems for salinity intrusion, floods, and other water-related hazards, improving preparedness and response (e.g. GRU, IJkdijk project and so on).

4. AI Applications in the Great Mekong River: Current state, Potentials and Challenges

Research on AI applications in the Mekong River Basin is still in its infancy. Literature reviews reveal that AI is often discussed and applied locally, such as in the Mekong Delta or the 3S River Basin, rather than across the entire Mekong Region. AI-powered technologies, particularly machine learning (ML), are frequently mentioned in research articles. These technologies have been applied in areas like hydrological regime forecasting, salinity intrusion prediction, and water availability assessment.

For instance, a study by Quyen Nguyen et al. (2023) evaluated the effectiveness of two ML algorithms—convolutional neural networks (CNN) and long short-term memory (LSTM) deep learning algorithms—in predicting the hydrological regime of the 3S River Basin under various climate change scenarios. Despite advancements in ML and AI for streamflow forecasting, there remains a noticeable lack of studies applying ML to streamflow modeling in the 3S River Basin. This basin is strategically important due to its significant contribution to the Lower Mekong River flow and its support for reservoir development initiatives. The study found that ML models (CNN and LSTM) were effective in predicting streamflow using daily mean temperature and precipitation data. This enables a better understanding of future hydrological trends, particularly the increased flood risk in the Sekong and Sesan catchments.

In another recent study conducted by Van-Hau Nguyen et al. (2024) on the application of machine-learning-based early warning systems and remote sensing for salinity intrusion in the Mekong Delta - a vital agricultural region in Vietnam often referred to as the country's rice bowl as well as one of the world's most productive rice-growing areas and agriculturally important for the development of aquaculture, fruit cultivation and fisheries. In their research, various ML strategies have been adopted in the salinity intrusion forecasting of the Mekong Delta. Utilizing 13 advanced ML algorithms together with principal component analysis for data optimization, the results clearly show the high level of prediction accuracy (from 86% to 100%) across models such as logistic regression, support vector classification, and random forest. The findings showed the accurate forecasting of salinity events, its efficacy and potentials of the ML in dealing with salinity intrusion, flooding and the intensification of climate change.

ML also proves its potential in groundwater mapping in researches by Nguyen Huu Duy et al. (2024) on 'Integrated machine learning and remote sensing for groundwater potential mapping in the Mekong Delta in Vietnam'. Particularly, the authors assess groundwater potential in Vietnam's Mekong Delta by using various ML models including SVM, CatBoost, KNN, Random Forest, and AdaBoost. By analyzing 146 groundwater points and 14 environmental factors, the models were evaluated on the basis of performance metrics such as area under curve (AUC), root mean square error (RMSE) and coefficient of determination (R^2). Among all the models, the Random Forest one showed the best performance, with an AUC of 0.99 and R^2 of 0.63. The findings showed that it has once again highlighted the effectiveness of ML in water management (specifically groundwater mapping in this case) which in turn provides valuable insights for sustainable water management of the region in the coming years.

Not yet applied AI but Liu et al. (2016) applications have been applied in satellite radar altimetry and remote sensing imageries to investigate the river flows impacts made by the two dams in the upper Mekong River (Xiaowan and Jinghong Dams within China) but only limited in the downstream of the dams in Yunnan, China. The versatile use of remote sensing and satellite data in water management is evident in the Mekong Dam Monitor, a digital, open-source platform that uses these technologies for near-real-time monitoring of dams, river flows, climate, and reservoir operations in the Mekong Basin. This platform exemplifies the dynamic application of modern technologies in managing the Mekong River Basin (U.S. Mission Cambodia, 2020; Stimson, n.d.).

In addition, the utilization of decision support systems (DSS) proves to be a 'fertile ground' for AI integration. DSS has been adopted in a project on 'Improving transboundary water management in the Mekong' to help manage water in the Sesan-Srepok (2S) river basins - large transboundary tributaries of the Mekong River shared by Vietnam and Cambodia (DHI, n.d.). Due to significant hydrological regimes from the hydropower management, operational regulations were established to ensure the stable flow conditions at the Vietnam-Cambodia border. Yet the lack of a sophisticated tool for the improved decision-making propelled the Vietnam's Ministry of Natural Resources and Environment (MONRE) and the Vietnam National Mekong Committee (VNMC) to develop an advanced DSS - a user-friendly and centralized system facilitates real-time flood management and water resources planning, while complying with legal requirements.

Overall, ML is the most popular AI-powered technology used in water management focusing on hydrological regimes as well as flood and drought forecasting. Future AI-enhanced technologies include remote sensing, satellite data/imageries as well as GIS can help Mekong River Basin at large to solve various issues from flood prediction and salinity intrusion forecasting to water reservoir and storage monitoring to name a few.

Despite its potential, literature of AI in water management is limited, mostly in a smaller community-sized rather than a Mekong River basin. Several challenges can be listed, including limited data availability and quality, technical expertise in data integration and algorithm building, financial constraints, infrastructure limitations, domestic policy and regulatory issues, regional cooperation framework and inter-state coordination.

- **Data availability and quality:** within the literature mentioned the utilization AI application in managing water sustainably in the Mekong region, most of the studies have been conducted at a rather small scope. Therefore, to thoroughly evaluate the effectiveness and usefulness of AI in transboundary water management of the Mekong River Basin, we must have more data and results from applications of similar AI technologies more widely to better judge the accuracy and advancement of AI in different water resources management matters.
- **Technical expertise in data integration and algorithm building:** Developing and implementing AI solutions requires specialized knowledge and skills. While findings have shown that the application of advanced technologies for water management including remote sensing, satellite imageries or GIS have been quite useful in tackling some water-related events such as flood and salinity intrusion. However, at the early stage of AI development, the ability to integrate data from the existing systems to make Big Data and develop AI algorithms is not easy. Technicians should integrate various AI technologies such as machine learning (ML), predictive analytics, Decision Support System (DSS), IoT, digital twins, dashboard, data analysis skills,... In addition, it requires AI technicians to expertise both AI techniques and water management, such as ability to analyze the upstream - downstream water flows, mixed with knowledge of local livelihoods to ensure the efficient water management for all local communities.
- **Infrastructure limitations:** Despite their willingness to digitalize the economy and advance AI, most of Mekong countries are economically developing countries. Therefore, not only technical expertise of AI, but also infrastructure and facilities to promote AI development in water management are indeed a major issue. According to Sandtech (2024) AI-powered technology in water management requires various facilities such as sensors, IoT devices, satellites, GIS or small meters to collect data, communication networks such as 5G and wifi for real-time connectivity, and so on, requiring a synchronized system with experienced technicians.
- **Domestic Policy and Regulatory issues:** Using AI technology in tackling those mentioned water management issues is essential because it may provide key insights on how communities and people of the Mekong Delta shall get ready and prepare for adaptation plans under various environmental scenarios (e.g. floods and droughts) that may threaten the daily routine of local people and cause great harm to agricultural and aquatic sectors. However, at the country level, there should be sufficient policy and legal corridors for local authorities, tech companies and residents to develop and invest in AI technologies as tools to address the listed issues.
- **Inter-state coordination:** As emphasized throughout our research, managing water in the Mekong River is a transboundary matter as one aspect of water management of one nation would affect the other. Data integration cannot be done without cooperation among Mekong countries. In addition, if AI could effectively help one riparian Mekong country tackle the challenges emerged at local riverine communities and areas within the nation as

in the case of the Mekong Delta in Vietnam, it will then support the overall effectiveness of transboundary water management of the entire Mekong River Basin. Therefore, there should also be relevant inter-state water management policy and regulatory framework for efficient coordination.

More importantly, it is critical to persuade all countries to balance the conflicting interests and sustainable development. As countries in the Upper Mekong River Basin tend to prioritize hydropower projects such as dam construction, this would generate conflicts against nations from the Lower Mekong River Basin considering the impacts of dams and hydropower projects from upstream on the water flows of the downstream which may lead to consequential outcomes on the agricultural development of the downstream nations. Meanwhile, Mekong water is a major transboundary issue, therefore, it requires countries to collaborate more actively on finding the grounds to balance their various national interests to ensure that the use and utilization of water resources in the Mekong River would align with the common interests and shared future of citizens and riparian countries in the region.

- **Regional Cooperation mechanisms for AI development:** Despite not always being on the top of the regional cooperation agenda, **water management** has always been referred to as one way or the other considering its vital aspect of riparian countries from navigation and hydropower potentials to agricultural development and livelihoods. However, AI has not yet been an agenda, therefore lack of cooperation protocols and guidelines for data integration as well as AI synchronization.

5. Outlook of AI cooperation in the region

The potential of AI in water management in the Mekong is undeniable, yet its application has been limited to local levels. Regionally, AI has not been formally integrated into Mekong cooperation mechanisms, though its future role is being explored. Riparian countries emphasize digitalization, with projects like the Mekong Integrated Water Resources Management indicating the potential of modern technology in enhancing water resources management. The MRC's data-sharing platforms and predictive analytics suggest AI could assist in transboundary water management (MRC, 2024).

In the Greater Mekong Subregion (GMS), digitalization is a key theme. Initiatives like the GMS Digital Economy Cooperation Initiative focus on promoting advanced technologies. Although AI is not yet integrated, these initiatives provide a foundation for future AI applications.

China, a major regional partner, has shown strong interest in AI. At the 9th Lancang-Mekong Cooperation Foreign Ministers' Meeting, China proposed strengthening AI capacity building through policy dialogue, joint research, and talent training. Efforts include AI-capacity building training and establishing a cooperation network for computing infrastructure (MOFA of the People's Republic of China, 2024).

The Mekong countries and regional cooperation mechanisms must build partnerships on digitalization and AI development. The 2024 Mekong-Japan Cooperation Strategy highlights digitalization, with initiatives like the Mekong Dam Monitor using advanced technologies for dam and environmental impact monitoring (MOFA of Japan, 2024).

Initiatives like the Mekong Dam Monitor (MDM), supported by the Mekong-U.S. Partnerships, utilize advanced technologies such as remote sensing and GIS analysis for environmental monitoring (MUSP, 2020). Integrating AI, including machine learning and NLP, can improve data handling, predictive modeling, and analysis of environmental changes, making these technologies more efficient and powerful.

5. Recommendations & Conclusions

Recommendations

Against such backdrops, AI-powered water management has potential to address the critical issues in water management in the Great Mekong region. AI integration does not only require technical calculations but also cooperative policies among countries. At its initial stage, to facilitate AI as an efficient instrument, an abundance of work must be done.

It is important to discover the minimal water expectations of each riparian country based on seasons, its livelihood and economic interests. This will help determine the AI expectations when integrating data and building relevant AI algorithms, from dam operations, water runoff and water flow measurement to water reservoir management, flood prediction and water salinity. Both water and AI expectations should meet the common purpose of the Mekong region, including sustainable economic growth, food and energy security, and biodiversity protection. Only when these criteria are met, countries can have a mutual understanding to develop AI in water management, particularly, and in all aspects in general.

It is also important to detect the boundaries and points that Mekong riparian states would not want to exceed in the use of AI is also another important matter considering national interests and willingness. Transboundary water issues and common shared problems of the Mekong may require higher consensus of countries in thinking about AI. However, monitoring the use of AI at an appropriate level would be important to make sure the integration of AI will not risk the national interests and development of member countries.

In addition, based on regional cooperation mechanisms and its protocols, plus the common grounds in water and AI expectations, an unified AI-driven water management framework should be established. There should be both national policies and inter-state agreements on data collection, sharing and standardization for water management to exchange high-quality data among Mekong countries. Ethical and responsible use of AI should be promoted by developing guidelines and regulations on data privacy, algorithmic transparency and bias in AI systems. The mechanisms also should encourage public-private partnerships to engage entrepreneurs in AI advancement and sustainable water use and management in the region, which can only be done when the inter-state and national policies are completed.

More importantly, there needs to be in-depth studies and exploration on the extent and actual level of AI integration in technologies such as remote sensing, satellite communication and GIS to better evaluate how AI has truly been applied across water resources management projects in the Mekong River Basin. Conducting further research and tests on different AI applications in forecasting floods, monitoring water levels as well as other water management issues to confirm the validity and effectiveness of AI in addressing challenging water issues in the Mekong Delta in specific and the Mekong River Basin in general. This would provide essential information for policymakers, researchers and practitioners in knowing which areas of AI-powered technologies have been adopted and the gaps that could be bridged.

In terms of capacity building, technical transfer, expertise sharing and training of AI in water management should be encouraged and promoted especially for water engineers/professionals in the Mekong Delta so that they can be better equipped with updated knowledge on utilizing AI in their field. China, as the AI dominant of the world, should lead the AI technical development and transfer as well as capacity building for government officials and technicians of all related countries. In addition, there should be periodical agendas and seminars to share knowledge and experience on all related fields such as AI in dam construction and operation, AI in water resources management, AI in disaster forecast, so that scholars, experts, government officials and technicians can update with new research and technologies and consider such implementation.

Conclusion:

In conclusion, this paper has highlighted the versatile utilities of AI in water management from both global and regional perspectives. Globally, AI proves to be a powerful tool in managing water resources and predicting disasters but regionally, in the Mekong River Basin, AI applications such as machine learning are at an initial stage, primarily used for flood and salinity intrusion forecasting, with countries working independently. The integration of AI into advanced technologies can significantly enhance the effectiveness of transboundary water management in the Mekong. Given the emphasis on technology and digitalization by both riparian countries, AI is poised to become a crucial component of regional cooperation mechanisms in the coming years. AI not only improves water management but also fosters collaboration among Mekong countries in addressing transboundary water issues.

However, the current application of AI in the Mekong is fragmented, with challenges including limited data availability and quality, technical expertise, financial constraints, infrastructure limitations, and policy issues. To overcome these challenges, it is essential to develop a unified AI-driven water management framework through regional cooperation channels. This framework should promote AI integration for sustainable development, enhance data sharing, and invest in capacity-building initiatives. National policies and regional cooperation frameworks must encourage all Mekong countries to engage in AI-powered water management, involving stakeholders such as entrepreneurs, scholars, and technicians in research and investment efforts.

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