

Navigating the Hydroelectric Dam Disputes in the Mekong River: A Psychological Game Theory Analysis

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Abstract

The hydroelectric dam dispute in the Mekong River has escalated, posing threats to dam development, economic growth, and regional security. In pursuit of understanding the pivotal factors impeding sustainable dam construction, this study performs a comparative analysis of three mainstream hydroelectric dams in Laos: Xayaburi, Don Sahong, and Pak Beng Dams. The psychological game theory (PGT) proves instrumental in dissecting the fundamental rationale underpinning each country's strategic yet occasionally irrational decision. By applying PGT to the three dams, this study uncovers that political asymmetry, mainly due to the inclusion of a powerful country, prompts participants to shift from a neutral to a fearful state of mind, leading to a seemingly irrational decision; the cessation of the Pak Beng Dam. The research findings hold substantial implications for hydroelectric dam discourse, as they open the avenue for fostering sustainable dam development, enhancing economic development, and bolstering regional security in the Mekong River.

Key Words: Mekong River, Hydroelectric dam, Psychological game theory, Political asymmetry, Regional Security

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I. Introduction

The conflict over transboundary water resources is an increasingly critical global issue. The Mekong River water resource conflict is particularly contentious due to ongoing debates concerning hydroelectric dams. Laos and China are actively involved in dam construction, while Cambodia and Vietnam, and Thailand at times, oppose these projects. The crux of the disagreement revolves around the potential repercussions these dams may have. Laos argues that the construction of hydroelectric dams is crucial for economic development, citing significant export potential for the electricity generated. Laos acknowledges that the construction does entail certain adverse effects, but contends that these can be effectively mitigated. However, Cambodia and Vietnam vehemently express their deep concerns regarding the detrimental environmental and social impacts, particularly in the river's mainstream.

The political tension in the Mekong region has steadily escalated, despite efforts such as establishing inter-governmental institutions and convening governmental meetings among riparian countries. This political instability poses threats to regional cooperation and economic development and would cause potential conflicts. Therefore, it is imperative to devise measures to mitigate hydroelectric dam disputes in Laos. While numerous studies have focused on the hydroelectric dams in Laos, the majority of them have primarily concentrated on assessing the potential environmental or social negative impacts. These previous studies have provided invaluable insights by shedding light on the repercussions and advocating for the development of

comprehensive standards for dam construction. However, there is a lack of emphasis on the planning stage of dam. The analysis on the planning stage is also pivotal for achieving sustainable dam construction without hampering regional stability as it contains exchange of riparian governments' controversial opinions. Therefore, this research conducts an in-depth comparative analysis of the planning stages of the three mainstream hydroelectric dams in Laos: Xayaburi, Don Sahong, and Pak Beng Dams.

Resolving the Mekong River disputes is challenging as it contains diverse sovereign nations that cannot be easily controlled. Therefore, it is crucial to estimate the logics behind each nation's behavior for peaceful dam construction. To unravel the decision-making logic and identify pivotal factors in the dam construction process, this paper employs the psychological game theory methodology. Psychological game theory effectively unravels incentive for player behavior based on expected behavior of other players. Furthermore, due to its dual characteristics encompassing both economic and psychological concepts, it adequately explains an individual's irrational behavior. Therefore, psychological game theory fits well with the complex circumstances in the Mekong Region. By addressing this research gap and offering a comprehensive analysis of the three key hydroelectric dams located in Laos, this paper aims to provide invaluable and pragmatic solutions for mitigating political tension while continuing with the construction of hydroelectric dams in the region.

In summary, this paper focuses on applying the PGT to three hydroelectric dams in Laos with the aim of figuring out the logic tree in the dam dispute and providing effective solutions to alleviate

political tensions in the region. To achieve this, this research will progress in the following structured manner: First of all, it will commence by offering an introductory overview of the hydroelectric dam dispute within the Mekong River Basin. This section will set the basic stage by providing essential concepts and background. Secondly, the research framework, psychological game theory, will be elaborated in detail. Additionally, each of the mainstream dams - namely, the Xayaburi, Don Sahong, and Pak Beng Dams - will be exhaustively examined. Based on the examination, the subsequent section will involve the application of the psychological game theory framework to assess the strategic decisions employed by the stakeholders in each dam project. By comparing the application results, the research aims to discern the most plausible reasons for the cessation of the Pak Beng Dam. Finally, the research will conclude by providing the invaluable insights and implications for the realm of hydroelectric dam construction in the Mekong Basin.

II. Major stakeholders in dam disputes in the Mekong River

The Mekong River has gained global recognition as one of the most significant transboundary rivers. It stretches through Southeast Asia and ranks as the twelfth-longest river worldwide. Originating in Tibet, it traverses Myanmar, Lao PDR (Laos), Thailand, Cambodia, and Vietnam. The river's water resources play a pivotal role in sustaining the communities residing within its basin who are heavily dependent

on agriculture and fishing industry. In recent times, the water resources of the Mekong River have increasingly been harnessed as a source of electricity, particularly by China and Laos. This development is driven by the rising energy demands stemming from rapid population growth and economic expansion in the region (Lacombe et al. 2014). Commencing with the Nam Pung Dam in November 1965, more than 160 hydroelectric dams have been erected along the river (Soukhaphon et al. 2021; Cowan 2023). However, this surge in dam construction has met with strong opposition from Cambodia and Vietnam, all located downstream.

The lower riparian countries, particularly Cambodia, Vietnam, and occasionally Thailand, assert that the construction of hydroelectric dams exerts a detrimental impact on the Mekong River and its communities across social, environmental, economic, and political spheres. In 1995, these concerns led to the establishment of the Mekong River Commission (MRC), an inter-governmental organization comprising Cambodia, Lao PDR, Thailand, and Vietnam. MRC members signed an agreement known as the “Agreement on Cooperation for the Sustainable Development of the Mekong River Basin.” underscoring cooperation for sustainable development in the region. One key tool arising from this agreement is the Procedures for Notification, Prior Consultation, and Agreement, a mechanism used to facilitate discussions to address potential adverse effects and acceptance for mainstream dam projects (MRC 1995). Before dam construction, feasibility studies which evaluate the potential impact of dams are prepared for the meeting: for instance, Environmental Impact Assessments (EIA) and Social Impact Assessments (SIA) are

representative. Based on the findings of feasibility study reports, the riparian countries convene to discuss any mitigation measures to minimize the adverse effects and determine the acceptability of dam construction (Yu & Chen 2022). However, despite the MRC's eagerness to mitigate the disputes, severe disputes among riparian countries have actively arisen and unresolved.

Laos underscores the critical importance of hydroelectric dams as a vital strategy for achieving sustainable development, not only within its own borders but also for the broader Mekong region. Laos argues that environmental and social risks will be adequately addressed through the implementation of additional measures devised by expert teams. In addition to this, Laos asserts its sovereignty to construct dams, generate electricity, and utilize or export it for its own economic benefit. As an emerging nation heavily reliant on traditional industries such as agriculture and fisheries, Laos continues to grapple with underdevelopment. The advent of hydroelectric dam has transformed electricity into Laos' primary export item, with Thailand serving as its largest trading partner. With countries in the Mekong region undergoing ongoing development, the demand for electricity is steadily increasing. Consequently, for Laos, the construction of hydroelectric dams is not a pursuit that can be easily abandoned.

Cambodia and Vietnam strongly contend that the negative impacts are significant and enduring, extending beyond the realm of control or mitigation. Moreover, they maintain that the involvement of Laos in supervising the feasibility study raises doubts about its objectivity. In this sense, the feasibility study investigated by Laos-friendly institutions is superficial which does not fully measure the

repercussions. Additionally, they point out that the assessments primarily concentrate on the immediate vicinity of the dam location, failing to fully capture the potential impacts that could extend to neighboring countries. In response, Laos refutes these criticisms by asserting that their assessments do include an examination of the cumulative impact of dam on the lower riparian countries. Furthermore, they emphasize that they have contracts with third-party institutions to implement EIA and SIA, reinforcing the reliability of these feasibility studies. The lack of consensus on these factors has deepened the political tension in the region, further complicating efforts to reach a resolution in the hydroelectric dam dispute.

While China plays a significant role in the dam construction in the Mekong River, this paper focuses on the dam projects conducted by Laos government and will not delve into China's dam construction projects. It is essential to note that this paper analyzes each state's ability to adjust their behavior based on their beliefs and the beliefs of others, necessitating the existence of behavioral responses. China's limited participation in discussions concerning hydroelectric dams within the Mekong Basin is well-proven (OpenDevelopment Mekong, 2016). It is because China considers utilizing the Mekong River is their own sovereignty which cannot be shared with the lower riparian countries (Soukhaphone et al., 2021). China is even known for lack of transparency and collaboration between central and local government (Tilt, 2015). Consequently, it presents a challenge to analyze China who rarely participate in the communication. Therefore, this paper will concentrate on Laos' dam projects, which promises meaningful insights for the Mekong Basin countries.

The escalating political tensions surrounding hydroelectric dams in the Mekong basin indeed present a growing concern, potentially transforming the region into an arena of hostility rather than peaceful cooperation. The resolution of these conflicts should be a top priority, given that they hinder regional development and elevate the risk of further conflicts. However, it is remarkably intricate to resolve dam disputes in the Mekong River as it encompasses diverse stakeholders who hold sovereignty. The research aims to address this intricate issue by investigating the logic behind the decisions made in three hydroelectric dam disputes. By addressing this issue, the research aims to contribute to conflict resolution in a region where the need for regional cooperation for sustainable development is urgent.

III. Psychological game theory applied to hydroelectric dam construction

Game theory proves invaluable in elucidating how individuals make strategic decisions concerning their behavior, taking into account the potential profits they would gain. It rationalizes specific actions by individuals with key concepts such as rationalization, self-interest, and equilibrium (Gibbons 1992). It fundamentally operates on the premise that individuals act in a rational and self-interested manner. Diverse studies in the field of water resources have used game theory as the theoretical framework to analyze water resource disputes among diverse players (Zahedi et al. 2023).

The existing literatures have analyzed dams or water resource

disputes by applying game theory. Zahedi and colleagues (2023) figure out that water resource conflicts were caused by ignorance of the interest parties towards the environment by applying game theory to the Shafarood Dam case study. Parrachino et al. (2016) demonstrate how to achieve cooperation over scarce water resources with cooperative game theory. Another study concludes that utilizing game theory is the most effective tool for water resource allocation management (Mahjouri & Ardestani 2010). Moreover, Zanjani and colleagues (2018) utilize the game theory and GMCR+ model to study the actions of stakeholders in resolving water resource conflicts. Existing research on dam disputes and game theory effectively figures out the logic or cause of the existing active dam disputes by analyzing the behavioral responses among participants in dam disputes. However, there is limited research on the conflict in the dam construction process which is vital for sustainable dam construction. Therefore, this study aims to figure out the main conflict causes during dam construction by applying game theory to three mainstream hydroelectric dams located in Laos.

While the traditional assumption in game theory posits that individuals act rationally and selfishly, it is essential to acknowledge that human behavior often deviates from this assumption due to factors such as humanitarian values, guilt aversion, and social norms (Azar 2019). In the context of hydroelectric dams, as Zanjani (2018) reveal, justice, which is far apart from pursuing selfishness, could be the most influential factor that resolve the conflicts. Such instances of economic irrationality are commonplace, highlighting a limitation in the traditional game theory to comprehensively explain

human behavior. To address this limitation, a new approach to game theory has emerged, placing greater emphasis on incorporating psychological considerations. In this sense, this paper determines to adopt psychological game theory as the main theoretical framework.

Psychological Game Theory (PGT) delves into how psychological factors, including emotions, reciprocity, and concerns about one's image, influence the process of human strategic decision-making (Battigalli & Dufwenberg 2022). This paper focuses on the fear-focused PGT that categorizes an individual's state of mind into two types: a neutral state of mind and a fearful state of mind.¹⁾ Typically, individuals maintain a neutral state of mind in the normal situation. In this state, they exhibit composure and can make rational decisions with sufficient time for consideration. However, unexpected situations can arise, which are recognized as perilous. Whether an individual transitions from a neutral to fearful state of mind can be determined by two factors: the degree to which peril is recognized and an individual's fear threshold (Andersson 2021). The fear threshold, also known as fear sensitivity, represents the maximum level of fear an individual can tolerate. If the perceived level of peril for an event surpasses an individual's fear threshold, they will shift from a neutral to a fearful state of mind. The fear threshold varies

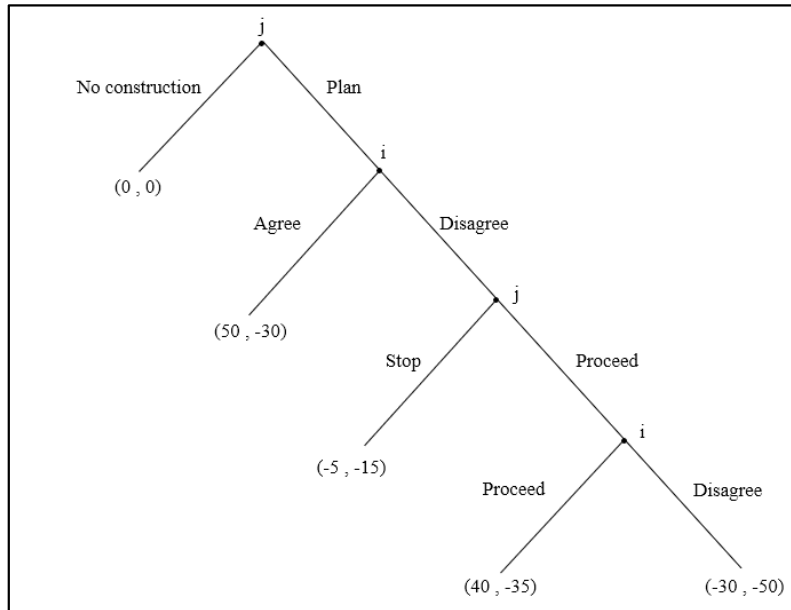
1) This paper's primary aim is to apply Psychological Game Theory (PGT) as a framework to analyze real-world case studies. PGT can involve complex mathematical formulations, which may not be easily digestible for non-experts. Therefore, in this paper, we have simplified the mathematical explanations as much as possible and have presented them in a narrative, accessible manner. For those interested in a more detailed mathematical exposition of Psychological Game Theory and the Fear-Focused Theory, we recommend referring to the works of Battigalli & Dufwenberg (2022) and Andersson (2021).

among individuals due to differences in their backgrounds and inherent traits (Geer 1965). Therefore, each person may respond differently depending on the event, time, or other external stimuli.

Fear is a potent emotion known to significantly influence one's behavior. When fear becomes activated in an one's mind, their subsequent behavior is often oriented towards eliminating that fear (Green & Kim 2006; Ruiter et al. 2014). Therefore, when the perceived level of peril associated with an event surpasses an individual's fear threshold, the behavioral pattern can deviate from the normal toward the way for eliminating fear, resulting in unconventional decision-making. Fear-focused PGT provides insights into these situations, logically explaining that individuals in a fearful state of mind prioritize minimizing their own material payoff. It is precisely for these reasons that this paper underscores the fear-focused PGT methodology in the analysis of hydroelectric dams, a complex and multifaceted topic that involves diverse stakeholders, including considerations of the environment, society, and politics.

Here, the following paragraphs provide a detailed account of how PGT is applied to analyze the hydroelectric dam dispute in the Mekong Region. The analysis begins with stage 1 which represents the plain situation. To aid in visualizing the decision-making process, a decision tree diagram below, outlining the fundamental structure of possible scenarios in the hydroelectric dam construction dispute, is presented. In this context, 'Player i ' and 'Player j ' represent the governments or countries involved, with i typically representing the electricity-purchasing country (e.g., Cambodia or Thailand), and j indicating the dam-constructing country (Laos).

<Figure 1> The possible scenario in the dam construction dispute



Consider a scenario where Laos and Thailand are on the verge of entering an electricity purchasing contract with electricity generated by newly planned hydroelectric dam. In the first stage, Laos, denoted as 'j', faces a critical decision: whether to start the dam construction in the Mekong River or refrain from doing so. If Laos opts not to build the dam at this initial stage, the circumstances remain unchanged, resulting in no material payoff for either country. However, if Laos chooses to advance with dam construction, the situation moves on to the second stage, where Thailand is confronted with a decision of whether to support or oppose the construction. Should Thailand decide to 'Agree,' it bears a negative material payoff. This is because dam construction has adverse social and

environmental impacts on Thailand, despite the economic benefits derived from electricity imports. For instance, Thai citizens may be forced to change their jobs due to the spillways that prevent fish from swimming to downstream, and the river's ecosystem could be disrupted. Conversely, Laos receives a positive payoff since it can export electricity generated by the new facility.

If Thailand chooses to 'disagree', Laos faces a critical decision in the third stage: whether to proceed with or halt the dam construction in light of Thailand's objection. Should Laos decide to cease construction due to Thailand's opposition, its payoff will be slightly negative as Laos has to put an effort into implementing retaliation toward Thailand. Due to Thailand's objection, Laos foregoes the opportunity for economic profit. Laos is well aware of this objection, which could lead to political retaliation or escalate political tensions. Therefore, as well as Laos, Thailand's payoff will be negative. However, the severity of political tensions is likely to be less than the environmental and social negative impacts. This distinction arises from the fact that retaliation level is not significantly high as Laos did not start the construction in earnest. Therefore, Lao's emotion may diminish over time. In contrast, the environmental and social repercussions are enduring and may persist until the dam is removed.

Thailand faces a crucial decision whether to support or oppose the dam's progress in the final stage if Laos chooses to proceed with the construction against Thailand's opposition. If Thailand decides to 'proceed,' Laos' payoff is positive but reduced compared to the second stage. This reduction occurs because, even though both the dam in the second and fourth stages yield the same amount of

electricity and economic profit, Laos must invest more effort into advancing the dam construction and mitigating the political tensions generated by opposing countries. On the other hand, Thailand's payoff is negatively affected compared to the second stage, but to a trivial extent. The negative payoff considers two factors: first, Thailand also invested considerable effort in the dispute process, and second, the dam would yield environmental and social repercussions. In this sense, the negative payoff should be upheaved compared to the second stage. However, Thailand can negotiate for more advantageous terms or compensation from Laos in exchange for acquiescing to the dam's progress. clearly works as positive payoff for Thailand. Consequently, although the dispute and construction were delayed, the payoffs for Thailand may not significantly decrease.

The most challenging scenario lies in the 'disagree' option, where Thailand chooses to halt the entire dam construction. As illustrated in the figure, this results in the most negative payoffs for both countries among all stages. Initially, Laos incurs a negative payoff as it spends resources on advancing dam construction, which includes conducting research on negative impacts and contracting construction companies. Furthermore, the heightened political tension and the cost on retaliation contribute to Laos' negative payoff in stage 4. However, the most substantial negative payoff is borne by Thailand. Firstly, Thailand could face economic retaliation from Laos, including reluctance to contract for electricity—an essential resource for Thailand's industry and economy. Additionally, Thailand may experience heightened political tension in the region. The importance of regional cooperation in Southeast Asian countries for mutual

regional development has been widely emphasized (Bakker et al. 2017). Consequently, an escalated political tensions would yield negative outcomes for Thailand. Finally, the costs incurred by Thailand to oppose Laos are counted as a strong negative payoff.

<Table 1> The components of each decision’s payoff in every stage

Stage		Components	
Stage 1	Plain	Laos	(0) None
		Thailand	(0) None
Stage 2	Agree	Laos	(+) Economic gains: generating and exporting electricity
		Thailand	(+) Economic gains: importing electricity (-) Environmental and social repercussions
Stage 3	Stop	Laos	(-) Costs on retaliation toward Thailand
		Thailand	(-) Experiencing retaliation; Political tension
Stage 4	Proceed	Laos	(+) Economic gains: generating and exporting electricity (-) Efforts to sustain dam construction project
		Thailand	(+) Compensation provided by Laos: electricity (-) Environmental and social repercussions; Efforts to prevent the construction project
	Disagree	Laos	(-) Economic loss for every planning activity; Political tension; Costs on retaliation toward Thailand
		Thailand	(-) Economic retaliation from Laos; Political tension; Costs to prevent Laos from building a dam

The costs preventing Laos from building a new dam are substantial compared to the other components. It is exceptionally challenging to halt a dam construction project, as it falls under the realm of a nation’s sovereignty. Consequently, the opposing country, in this case Thailand, must exert significant efforts to contest Laos’ dam construction plans. At first glance, Thailand’s choice of the “disagree” scenario in stage 4 may seem irrational, as it contradicts the traditional game theory premise of maximizing utility. However, the fear-focused psychological approach helps rationalize this decision. When an unexpected perilous event

occurs, Thailand transitions from a neutral to a fearful state of mind. The example of perilous event could be serious oppression from neighboring countries not to proceed dam project, severe repercussions caused by dams, involvement of a powerful nation in the dam construction, and so on. In this fearful state, Thailand's decision is driven by the desire to minimize its payoff. The table 1 outlines the factors considered when calculating each payoff in every stage of the analysis.

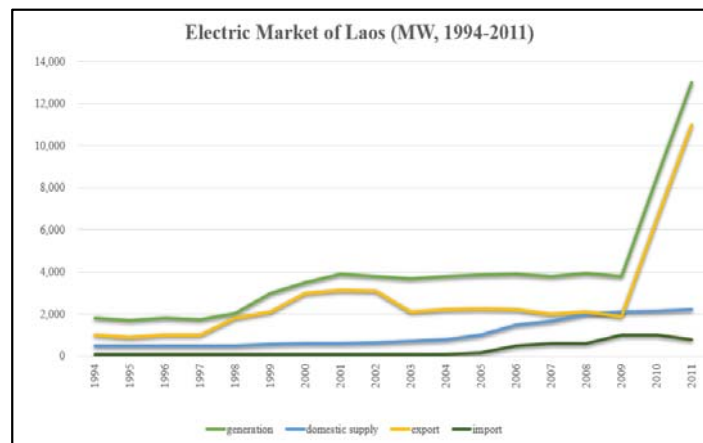
IV. Exploring the three mainstream hydroelectric dams in Laos

Lao PDR, situated in Southeast Asia, is a landlocked country with a population of approximately 6.3 million. The majority of its residents heavily depend on the agriculture and fishing industries. Consequently, a significant portion of the Laotian population lives in impoverished conditions. According to the World Bank (2023), in 2010, access to electricity in Laos stood at 70%, with rural areas reporting even lower rates, falling below 60%. However, since the hydroelectric dam operation has begun, even rural areas have witnessed a remarkable increase, with rates exceeding 95%. This positive transformation can be attributed to the active development of hydroelectric dams in Laos. The country has designated itself as the 'Battery of Southeast Asia', given its abundant hydroelectric resources. This national strategy is aimed at eradicating persistent poverty in Laos and fostering comprehensive national development. Hydroelectric power has emerged as the linchpin of Laos' economy,

playing a pivotal role in its national development.

Electricity generated by hydroelectric dams, as time passes by, stands as Laos' principal export item, underscoring the country's determination to continue developing hydroelectric projects. The Nam Ngum Dam, situated in a tributary river, was the beginning of this endeavor. Furthermore, the operation of the Nam Theun II dam in 2010 resulted in a remarkable increase in electricity generation within Laos, as demonstrated in figure 2. A substantial portion of the electricity generated by these hydroelectric dams is exported to neighboring countries, where the demand for electricity continues to escalate. Laos has been exporting a substantial portion of the electricity generated by these hydroelectric dams to neighboring countries, where the demand for electricity continues to escalate.

<Figure 2> Trend of the electric market of Laos from 1994 to 2011



Source: Giovannini, 2018

The profits generated by dams illustrates why Laos is reluctant to relinquish its right to construct additional dams in the Mekong River,

despite encountering substantial opposition from Cambodia and Vietnam. Three dams have attracted significant attention and protests from neighboring countries due to their planned locations in the mainstream of the River; Xayaburi, Don Sahong, and Pak Beng Dam. Of these three dams, the Xayaburi and Don Sahong Dams managed to withstand serious criticism and proceeded with construction, while the Pak Beng Dam was forced to halt. To discern the primary differences among the three dams, this research will examine each dam and specifically two key documents (Environmental Impact Assessment - EIA and Social Impact Assessment - SIA). Additionally, various research studies primarily conducted by opponents of the dams will be reviewed. The figure 3 provides a visual representation of the locations of these hydroelectric dams.

<Figure 3> The location of three hydroelectric dams in Lao PDR



Source: RFA, 2019

1. Case study 1: Xayaburi Dam

The Xayaburi Dam, located in the Xayaburi province and designed to generate 1,285MW, was initially proposed in the early 2000s and received approval from the Mekong River Commission (MRC) in 2010. As the first dam proposed for construction in the mainstream of the Lower Mekong Basin, the Xayaburi Dam underwent extensive evaluations and faced strong opposition from the lower Mekong countries. The government of Laos entered into a Memorandum of Understanding (MoU) with CH Karnchang, a Thai company, to oversee the EIA and SIA. In 2008, the Thai company enlisted TEAM Consulting and the Swiss company Colenco to assess the feasibility of the dam. Additionally, Laos signed an agreement with Thailand to export electricity generated by the dam.

According to the EIA, dam construction is expected to have certain environmental impacts, including surface water quality, fishery loss, and aquatic ecology. However, the assessment categorizes these impacts as minor or moderate and suggests mitigation measures identified to alleviate adverse effects. The SIA also acknowledges negative effects on the local population in the absence of mitigation measures, including the destruction of agricultural land, fishing areas, and disruption to social assets such as hospitals, schools, and temples. Nevertheless, the research suggests that appropriate mitigation methods, including resettlement, can significantly mitigate the social impact, making it feasible to proceed with the dam project. Furthermore, the report highlights the positive effect of new road construction prompted by the dam on local villages by improving

connectivity with other communities. Based on these two documents, the Xayaburi Dam's negative impact is assessed as minor or manageable.

Cambodia and Vietnam, however, expressed substantial dissatisfaction with the EIA and SIA, voicing significant concerns about the Xayaburi Dam's potential impact. They called upon the MRC to discourage its construction. Moreover, a number of researchers have issued warnings on the long-term sustainability of the Mekong River ecosystem. They argue that the assessments inadequately address the potential impacts on the cross-border regions in Cambodia and Vietnam. In response to the non-recognition of the EIA and SIA, another investigation known as the Strategic Environmental Assessment was initiated. This assessment suggests that the two previous documents may have overlooked critical environmental impacts associated with the Xayaburi Dam. Stone (2011) asserts that the dam could result in fisheries losses and food security erosion. Herbertson (2012) highlights the potential disruption of sediment and nutrient flow, as well as the blocking of fish migration resulting from dam construction. Furthermore, Le (2013) argues that while the Xayaburi Dam brings significant benefits to Laos, it simultaneously threatens food security and regional stability. The literature on the Xayaburi Dam predominantly delves into the environmental and social damage posed to fisheries and local communities. Despite these significant objections, the Xayaburi Dam was ultimately constructed and is now operational.

2. Case study 2: Don Sahong Dam

The Don Sahong Dam is a run-of-river hydroelectric dam located in the Khong District of Champasak Province, Laos. Designed to generate 260 MW of power, it straddles the border between Laos and Cambodia. The electricity produced by the Don Sahong Dam is primarily earmarked for export to Thailand and Cambodia. In 2006, the Lao government entered into a MoU with the Malaysian firm Mega First Corporation Berhad (MFCB) to launch dam construction. EIA and SIA for the project were conducted by the National Consulting Company in Vientiane, Lao PDR. The Don Sahong Dam also underwent a prior consultation process with the MRC members. However, similar to the situation with the Xayaburi Dam, a consensus could not be reached. Despite the controversy, Laos initiated the project and, in 2015, signed an additional contract with the Chinese company Sinohydro for technical support (N.H. 2015). Construction was completed in 2019, and the dam started operations in 2020.

The EIA concludes that while there are some minor side effects, they can be easily reduced or eliminated with having no significant cumulative impact on neighboring countries. Additionally, it notes that the initial environmental condition is somewhat poor, especially concerning wildlife, aquatic animals, and fisheries (National Consulting Company Vientiane, Lao PDR, 2013). The document highlights the benefits of constructing the dam, such as reducing the use of fossil fuels and alleviating poverty. On the other hand, the SIA acknowledges the need to resettle some villages and negative impact on fisheries. However, the necessity of resettlement will be mitigated

through compensation. It also underscores the potential benefits of the project, particularly the enhancement of social infrastructure. The document suggests that improved transportation will increase the income levels of local people by connecting them to other villages and markets. The dam construction is also expected to expand employment opportunities, enabling local people to earn more than before. In summary, both documents indicate that the dam's impact is not significant and can be effectively mitigated.

Prior research on the Don Sahong Dam, however, presents a different perspective compared to the assessments. Ian (2011) raises concerns about the dam's repercussions on fisheries, including losses in nutrition and income, leading to increased poverty. The dam is also seen as impeding fish migration and affecting dolphins (World Wildlife Fund 2014; Ryan 2014). Intralawan and colleagues (2017) argue that the dam is not essential for Laos and the potential fishery losses outweigh the economic benefits. The majority of literature on the Don Sahong Dam focuses on its adverse impact on fisheries. Nonetheless, the Don Sahong Dam was completed and has been operational since 2020, despite facing opposition.

3. Case study 3: Pak Beng Dam

The Pak Beng Dam is the hydroelectric project situated in the mainstream of the Mekong River. Designed to generate 912MW, it is a run-of-river type dam located in the Oudomxay Province of Laos. In 2007, the government of Laos signed a MoU with the Chinese firm Datang International Power Generation Company to commence

the construction of the Pak Beng Dam (Suhardiman & Geheb 2021). However, unlike the other two dams, the Thai government, which was intended to be the subject of the Power Purchase Agreement (PPA), exhibited hesitancy in the process. Consequently, the construction of the Pak Beng Dam was halted, and the anticipated completion year, originally set for 2023, is now expected to be in 2029 or possibly further delayed due to unforeseen factors. It was not until September 2023 that the PPA was finally signed between Thailand and Laos (BenarNews 2022). The dam construction is now set to commence after a 16-year hiatus from 2007. However, the delay in the PPA for the Pak Beng Dam, compared to the other two dams that had their agreements in place from the outset, has garnered significant attention. Therefore, it is meaningful to examine the significant obstacles that the Pak Beng Dam encountered.

The feasibility study, titled 'Transboundary Environmental and Social Impact Assessment & Cumulative Impact Assessment', was conducted by the Chinese firm Kunming Engineering Corporation Limited. Independent reports on the EIA and SIA are not publicly available in the MRC's open database. However, the aforementioned document consolidates the findings of the EIA, SIA, and cumulative impact assessment, allowing for an examination of the repercussions of the Pak Beng Dam. According to the report, the environmental and social impact of the dam is considered insignificant, similar to the other two dams (Kunming 2015). The document indicates minor impacts on water flows, fish migration, and fisheries without adverse effects anticipated in Cambodia. Consequently, no distinctive features of the Pak Beng Dam, compared to the other two dams, were

identified in the investigation.

Given that the dam construction has not progressed, there is limited availability of peer-reviewed journals focused on the Pak Beng Dam. However, cautionary media reports have raised concerns about the potential environmental and social impacts, particularly related to fisheries. One interesting point is that media coverage has shown an unusual pattern by highlighting the nationality of the construction company of the Pak Beng Dam, often using terms like ‘China-backed’ (Gerin 2022; BenarNews 2022). This emphasis on the company’s nationality is not observed in the case of the other two dams.

4. Discussion

When examining three hydroelectric dams in Laos, it becomes evident that there are no significant differences in terms of their environmental and social repercussions. Environmental and social impact assessments for all three dams produced similar results, suggesting that potential effects can be effectively mitigated. In terms of opposition, the volume of warning research on Pak Beng Dam was meaningfully less than the other dams. To sum up, when scrutinizing official documents, this paper finds that there is insignificant insight that highlights the reason of Pak Beng Dam construction’s failure.

One notable distinction, however, emerges concerning the Pak Beng Dam. Unlike the other dams, which primarily involve stakeholders from politically and economically similar countries, the Pak Beng Dam project is financed and managed by a Chinese enterprise. China’s significant influence and resources set it apart from

neighboring Asian countries in all aspects. While the Don Sahong Dam has also been associated with a Chinese firm due to the late involvement of Sinohydro, the official management rests with a Malaysian firm creating a noteworthy difference compared to the Pak Beng Dam's official documentation as a Chinese-financed project. Furthermore, various media outlets emphasize that the Pak Beng dam is being developed by a Chinese firm, whereas articles about the other two dams only highlight the negative impacts of the dams on the environmental and social sectors. This indicates that, even though the dam is officially controlled and owned by the government of Laos, there are concerns regarding China's participation in the project. Considering these factors, it has become crucial to investigate the political variable as the major influencing stimulus.

V. Application to psychological game theory

In this section, this paper applies fear-focused psychological game theory based on the information and construction outcomes of each dam. A concise table below provides essential information on the three dams. It is important to note that within each row of variables, except for the 'Progress' variable, any of these factors could potentially trigger a state of fear.

<Table 3> Summary of three hydroelectric dam projects in Laos

	Xayaburi Dam	Don Sahong Dam	Pak Beng Dam
Progress	Completion	Completion	Delayed *PPA made: <i>Sept. 2023</i>
Location	Middle	Most downstream	Most upstream
Capacity	1,285MW	260MW	912MW (planned)
Main construction company	Thailand “CH Karnchang”	Malaysia “Mega First Corporation Berhad” + Technical help : Sinohydro (Chinese)	China “Datang International Power Generation Company”
EIA & SIA	Positive	Positive	Positive
Literature review	Negative	Negative	Cannot evaluate
Increased # of dams	(2000) $\Delta = 18$	(2010) $\Delta = 18$	(2020) $\Delta = 36$

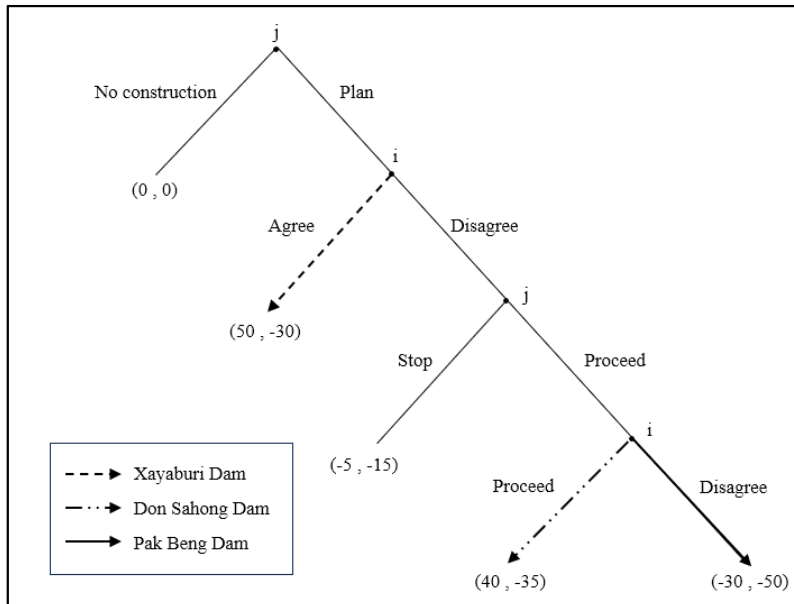
To control the time variable when assessing the peril associated with constructing hydroelectric dams, this paper added data on the increased number of hydroelectric dams constructed in the Mekong Basin during three distinct time periods (OpenDevelopment Mekong 2022); until 2000, from 2001 to 2010, and from 2011 to 2020. The results elucidate that the hydroelectric dam constructions is not negatively affected by the cumulative history of dam disputes. The fear threshold of dam opposing countries did not significantly increase as time passed. In other words, it is not plausible to attribute the cessation of the Pak Beng Dam solely to the strengthened hydroelectric dam dispute. There must be other factors that may interfere with the dam construction. This paper identifies several significant fear stimuli variables that exist in the hydroelectric dams in Laos: physical location, electricity generation capacity, environmental and social repercussions, literature review, and the main constructing partner.

To begin with, the physical location has the potential to evoke fear in lower riparian countries. If a hydroelectric dam is situated closer to these nations, the likelihood of recognizing the construction of a new dam becomes more pronounced, subsequently increasing the perceived peril. In this context, the perceived peril, with respect to the location variable, is most pronounced in the case of the Don Sahong Dam and least significant in the case of the Pak Beng Dam. Furthermore, the planned capacity generated by each dam serves as a fear-inducing factor. It is reasonable to assume that a dam with a larger capacity would have a more substantial environmental impact on neighboring and downstream countries, given its larger infrastructure, land requirements, reservoir size, and groundwater usage. Therefore, as a significant fear stimulus, the perceived peril related to the capacity variable is highest for the Xayaburi Dam, followed by the Pak Beng and Don Sahong Dams.

The environmental and social negative impacts are typical factors that can evoke fear in dam-opposing countries. Numerous studies have drawn attention to the environmental and social repercussions associated with hydroelectric dam (Wolanski et al. 1998; Hecht et al. 2019; Huy et al. 2022). While the energy generated by these dams is considered renewable, the dam construction and operation can have detrimental effects on the Mekong River's ecosystem and people whose livelihoods depend heavily on the river. Additionally, continuing media coverage and numerous research that raise concerns against the dams contribute to the heightened sense of peril associated with these projects. This is why this paper considers variables such as the EIA, SIA, and literature review as major factors in the analysis.

Finally, the choice of a major construction partner is a significant fear-inducing factor in this analysis. When a new hydroelectric dam is planned, the government enters into a contract with a construction company. Additionally, the construction company is responsible for contracting with a monitoring firm to carry out the EIA and SIA. This underscores the pivotal role that the construction company plays in shaping the identity of the hydroelectric dam construction project. For example, if the construction company has a reputation for being meticulous and stringent in adhering to regulations, there is a lower likelihood of generating negative impacts or neglecting adequate mitigation measures. Conversely, if the construction company is known for environmental and social abuses, concerns about the repercussions of the project are likely to escalate, leading to

<Figure 4> Application result of PGT on three hydroelectric dams



heightened worry among stakeholders. Therefore, information related to the construction company functions as a major fear stimulus.

The variables discussed above have now been incorporated into the analysis, and this paper determines which of these variables serves as a significant determinant influencing the progress of dam construction. The figure 4 presents the application results for each hydroelectric dam, and the subsequent section will provide a detailed explanation and the underlying logic behind each dam construction project, step by step.

1. The Xayaburi Dam

In the case of the Xayaburi Dam, Laos (*j*) planned to construct the dam in the mainstream of the Mekong River, and Thailand (*i*) was the country that entered into a power purchase agreement with the Laos. When Laos announced its plan to build the Xayaburi Dam, it triggered opposition from the lower riparian countries, Cambodia and Vietnam, primarily because it was the first mainstream dam planned by Laos. Despite their objections, the level of concern expressed by Cambodia and Vietnam was not significant enough to prevent the contract between Laos and Thailand. Thailand, in particular, had a strong need for electricity to support its industrial and economic development, so it chose to agree with the dam construction in stage 2. Consequently, Laos entered into a MoU with the Thai company CH Karnchang, indicating that Thailand prioritized electricity supply over concerns about environmental and social impacts. This ultimately led to the successful completion and

operation of the Xayaburi Dam.

Despite being the first mainstream dam with the largest planned capacity among the three dams, the Xayaburi Dam did not pose a significant peril that would surpass Thailand's fear threshold. Its location, which was relatively upstream and closer to China than Cambodia or Vietnam, contributed to this. Additionally, the EIA and SIA indicated that while there were some negative consequences for the environment and local communities, these could be effectively mitigated with appropriate measures. Most importantly, the primary stakeholders involved in the construction were Mekong Basin countries, and the dam was monitored and operated by a Thai company, a member of MRC. This gave the impression that the project would adhere to MRC rules and regulations, reducing the level of criticism from Cambodia and Vietnam. Consequently, the increased peril for Thailand did not exceed its fear threshold. Thailand, in a neutral state of mind, rationally considered the material payoff it would gain from the Xayaburi Dam project.

2. The Don Sahong Dam

In the case of the Don Sahong Dam, Cambodia (*i*) initially strongly opposed the proposed hydroelectric dam located in the mainstream of the Mekong River, with Laos (*j*) as the country planning its construction. Despite being planned with the smallest capacity among the three dams, the Don Sahong Dam's proposed location at the national border between Laos and Cambodia significantly increased

the perceived peril of Cambodia. This geographical proximity was one of the key reasons why Cambodia initially declined to agree to the dam's construction. However, in stage 3, the Lao government successfully negotiated and compromised with the Cambodian government. They offered a power purchase agreement for electricity generated from the Don Sahong Dam, which appealed to Cambodia due to its economic benefits and increased domestic demand for electricity resulting from industrial development. Furthermore, the main construction company chosen for the Don Sahong Dam was a Malaysian firm. While Malaysia is not a member of the MRC, its involvement did not introduce significant political asymmetry in the region, and thus, its participation did not raise the peril to a level that would surpass Cambodia's fear threshold.

The EIA and SIA reports concluded that the Don Sahong Dam's impact is not significant. Additionally, the literature review did not significantly alter the perceived peril. One unanticipated fear-arousing variable was the late involvement of a Chinese firm in the project, although its role was limited to providing technical feedback on the dam's construction. Considering that the main construction company was officially identified as Malaysian, the perceived peril associated with China's participation was relatively lower. Also, unlike the Pak Beng Dam, media does not give attention on the participation of Sinohydro to the Don Sahong Dam. As a result, Cambodia and Laos made decisions to proceed with the construction in stage 4. Although the payoffs for both countries were slightly decreased compared to stage 2, all decisions made by both players were rational and understandable in each stage.

3. The Pak Beng Dam

The case of the Pak Beng Dam is particularly intriguing within this study. In this case, *i* represents Thailand, and *j* represents Laos. Being located far upstream and having a capacity between that of the Xayaburi and Don Sahong Dams, there was initially no apparent reason for significant opposition to its progress. Moreover, the volume of articles criticizing the Pak Beng Dam was substantially lower compared to the other two dams. Given these factors, it would seem logical for the Pak Beng Dam to progress smoothly. However, it faced a delay of over 15 years, primarily due to Thailand's hesitation in making a power purchase agreement with Laos. Even with the recent contract between Laos and Thailand, the dam's construction still faces a considerable level of opposition, including from the Thai population. Therefore, the completion of the dam remains uncertain.

One significant difference in the level of fear-arousing variables between the Pak Beng Dam and the Xayaburi and Don Sahong Dams was the major construction company. The Pak Beng Dam was planned to be constructed under the control of the Chinese firm "Datang International Power Generation Company." This marked the first China's involvement in the mainstream hydroelectric dam within Laos. China's inclusion reasonably aroused fear among the Mekong Basin countries. China's role as a regional hegemon added the pressure on these countries, establishing a clear power asymmetry in the region. While China had been involved in dam construction projects in the past, all of them were located in tributaries rather than the mainstream of the river. This difference led Thailand to hesitate

in signing the PPA. The fear of China's inclusion is robustly evidenced by media reports, as mentioned earlier. Unlike the other two dams, the Pak Beng Dam was frequently referred to as "China-backed" in several articles. This naming convention highlights the concerns people have regarding China's participation in hydroelectric dam construction, and Thailand was no exception. China's lack of cooperation in hydroelectric dam construction projects led Thailand to increase its perceived peril regarding the dam.

Consequently, the increased peril surpassed Thailand's fear threshold. Transitioning to a fearful state of mind, Thailand chose the "disagree" option in stage 4 to halt the dam's progress until 2023, despite the negative consequences associated with this decision. Thailand's choice to disagree may seem irrational given that it leads to political tension with Laos and a reduction in electricity returns. Thailand remained in this irrational state until 2023 when it finally changed its decision by entering a power purchase agreement with the Lao government. This change indicates that Thailand overcame its fearful state of mind and transitioned to a neutral state. In this neutral state, Thailand could change its action from pursuing a minimized payoff to maximizing payoff. However, as there is no sign of further progress in building the Pak Beng Dam, whether Thailand truly overcomes the fearful state of mind should be kept monitoring. The case of the Pak Beng Dam illustrates the logic behind irrational actions and discloses that fear drives a state to make such decisions.

4. Application results

In each section, the scenarios of the three hydroelectric dams were analyzed using fear-focused psychological game theory. The Xayaburi Dam completed its decision tree in stage 2, representing the most peaceful decision process among the three dam cases. The Don Sahong Dam progressed to stage 4, resulting in a successful construction despite some conflicts between Laos and Cambodia. On the other hand, the Pak Beng Dam reported over about 15-year delay in its progress, and even though Thailand and Laos eventually made a contract to trade electricity generated by the Pak Beng Dam, construction has not yet commenced. To identify the major differences among the dams, this paper compared all potential fear-arousing variables, including the dam's location, capacity, EIA and SIA, literature review, and the main construction company while controlling the time variable. The most significant difference between the two completed dams and the delayed Pak Beng Dam was related to the main construction company. Specifically, the power asymmetry resulting from the inclusion of China in the discussion was a powerful fear stimulus for countries affected by the dams.

The power asymmetry significantly increased the peril associated with building the Pak Beng Dam, clearly surpassing Thailand's fear sensitivity. China's full participation in the project led Thailand to feel fearful about the construction, primarily because of China's historical lack of cooperation on water resources in the Mekong River. This lack of cooperation has resulted in numerous side effects for lower-riparian countries over the decades. Given this history, Thailand

had significant concerns about China's major involvement in the Pak Beng Dam project, and this fear was a driving force behind Thailand's irrational behavior. While various researchers have emphasized the environmental and social negative impacts as critical factors influencing hydroelectric dam progress, the application of psychological game theory to the three dam cases suggests that it was political asymmetry, typically caused by China, that led to the 15-year delay in the construction of the Pak Beng Dam.

VI. Conclusion

Hydroelectric dam construction remains a highly contentious issue in the Mekong River region. Laos, driven by its economic and developmental needs, emphasizes the importance of hydroelectric power generation, positioning it as a key export. However, Cambodia and Vietnam strongly oppose dam construction due to the potential negative environmental and social impact. As a result, it is expected that disputes over hydroelectric dam construction will intensify in the future, further threatening regional security. As riparian countries are actively pursuing economic development, it becomes increasingly important to foster regional cooperation. Therefore, addressing the disputes related to dam construction and finding ways to reduce political tensions in the region should be prioritized. This requires careful consideration of the concerns and interests of all parties involved, as well as seeking diplomatic and cooperative solutions to ensure the sustainable development of the Mekong River basin.

To comprehend decisions of two governments in dam construction, this research utilized the fear-focused psychological game theory and conducted comparative analysis of three mainstream dams in Laos. In order to understand the underlying reasons behind Thailand's reluctance to enter into a contract with Laos for the Pak Beng Dam, this study thoroughly examined all potential fear-arousing stimuli related to hydroelectric dam construction. These variables encompassed the dam's location, capacity, EIA and SIA reports, literature reviews, and the main construction company. When considering all variables except for the main construction company, the Pak Beng Dam was evaluated as having the lowest level of perceived peril. The dam was planned to be located at the most upstream point of the river, and its planned capacity fell in the middle range between the Don Sahong and Xayaburi Dams. There were no significant differences in the EIA and SIA variables among the three dams. Additionally, the volume of research focused on the Pak Beng Dam was notably lower than that of the other two dams. The analysis indicates that the main construction company was the most significant factor capable of increasing the peril associated with the construction.

The Lao government entered an MoU with the Chinese company to build the Pak Beng Dam. The involvement of China as the primary stakeholder has introduced a significant power asymmetry that heightens concerns among the Mekong countries. The Don Sahong Dam, while also receiving some assistance from the Chinese company "Sinohydro," had its main construction management overseen by the Malaysian company. This difference in management significantly reduced the perceived peril associated with the Don Sahong Dam,

keeping it below the fear threshold. However, the pronounced power imbalance introduced by China's central role in the Pak Beng Dam project has substantially elevated the perceived peril of its construction. This increased peril has been sufficient to shift Thailand's state of mind from neutral to fearful, making the construction of the Pak Beng Dam politically unacceptable to Thailand. This application of PGT underscores the critical importance of effectively managing and addressing political asymmetry in hydroelectric dam construction in the Mekong River.

In conclusion, this paper has shed light on the critical role of political asymmetry as a key fear stimulus in hydroelectric dam construction dispute. This finding highlights that effective management of political variables is not only essential for the success of dam construction but also crucial for regional security by mitigating political tensions. The political instability can hinder Laos' long-term development by impeding foreign investment, capital inflow, and international cooperation, all of which are vital for national prosperity. Therefore, the Lao government must proactively manage the political aspect when embarking on hydroelectric dam projects. Furthermore, this conclusion opens new avenues for future study on how to reduce the political variable's level of peril. Suggestions include finding ways to enhance cooperation with powerful stakeholders like China, sharing information transparently with lower riparian countries, and seeking collaborative solutions to address concerns effectively. Moreover, while this research limits the scope to Lao's dam projects, further research on China's dam project perspective is also necessary. With such efforts, the hydroelectric dam

disputes in Mekong region would be resolved in more sustainable way, and riparian countries can collectively achieve economic prosperity and regional stability.

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<Abstract>

메콩 강 유역 수력댐 건설 분쟁: 심리학적 게임 이론을 통한 분석

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현재 메콩 강 유역에서의 수력댐 분쟁은 과열되어 댐 개발뿐 아니라 경제발전, 심지어 지역 안보까지 위협을 가하고 있다. 본 연구는 성공적인 댐 건설을 방해하는 중요한 요소를 분석하기 위해 메콩강 분류에 위치한 세 개의 수력댐(Xayaburi, Don Sahong, Pak Beng)에 대한 비교 연구를 진행하였다. 심리학적 게임 이론(PGT)은 댐 건설 분쟁에 참여하는 국가가 선택한 전략적인 결정과 비이성적 결정의 논리를 파악하는 데 효과적인 역할을 수행한다. 심리학적 게임 이론을 연구 분석틀로 사용하여 사례 연구를 진행한 결과, 정치적 불균형이 댐 건설 방해의 주요 요인으로 나타났다. PGT는 댐 건설 과정에서 발생한 정치 불균형으로 인해 참여 국가가 중립적 상태에서 공포의 상태로 전환되고, 따라서 비이성적으로 보이는 Pak Beng 댐 건설을 중단하는 결정 과정을 논리적으로 보여준다. 본 연구 결과는 메콩 유역에서 지속적인 댐 건설, 경제발전 및 지역 안보 증진을 위한 새로운 장을 제시하였다는 점에서 중요한 정책적 시사점을 준다.

주제어: 메콩 강, 수력댐, 심리학적 게임 이론, 정치적 불균형, 지역 안보