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NAVIGATIONAL FLUCTUATIONS OF THE TONGHUI CANAL DURING THE MING DYNASTY

Zhang Xiaomei
Independent Researcher
The People's Republic of China (PRC)

Ku Boon Dar*
School of Distance Education,
Universiti Sains Malaysia, 11800 Penang, MALAYSIA

***Corresponding Author: kubd@usm.my**
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Abstract

The Tonghui Canal served as an essential route for grain transportation between Beijing and Tongzhou, undergoing significant fluctuations in navigability influenced by the dynamics of grain transportation and state governance during the Ming dynasty. This study aims to investigate the reasons behind the recurrent cycles of navigational disruption and restoration of the Tonghui Canal throughout the Ming dynasty. It analyses the fluctuating navigation of the Tonghui Canal within a historical framework, employing a qualitative methodology. It combines historical approaches, including historical-analytical, inductive analysis, and dialectical examination of historical records, thereby illustrating the navigational fluctuations of the Tonghui Canal. While previous scholarship has largely offered descriptive accounts of canal construction and maintenance, this study explicitly addresses the research gap by examining the Tonghui Canal as a dynamic site where political authority, economic interests, and hydraulic technology intersected. The main findings identify three principal elements that contribute to this instability. Initially, fluctuations in Beijing's political status and economic issues directly influenced the demand for the Tonghui Canal's grain navigability. Secondly, economic concerns related to the Tonghui Canal generated competition and conflict among diverse stakeholder groups, thus intensifying the instability of its transportation operations. Thirdly, fluctuations in water resources and constraints in hydraulic engineering technology significantly impacted the Tonghui Canal's navigability and sustainability. By moving beyond narrative exposition, the originality of this study lies in demonstrating how the Tonghui Canal not only reflected technical and environmental challenges but also functioned as a lens to analyse broader questions of Ming state governance, centre–periphery relations, and institutional resilience. This study reconstructs the development trajectory of the Tonghui Canal's navigation history and analyses sample cases, providing new insights into the interaction between state governance and waterway networks throughout the Ming dynasty.

Keywords: Tonghui Canal, Ming Dynasty, Grain Transportation, Governance, Fluctuations

Introduction

Throughout history, access to reliable water resources has been a key determinant of human settlement, supporting not only domestic consumption but also economic activities, transportation, and communication, as noted by Mohd Firdaus Abdullah and Arba'iyah Mohd Noor.[1] Consequently, waterways frequently served as catalysts for urban growth, commercial exchange, and state integration. The Tonghui Canal is the Beijing-Hangzhou Grand Canal's northernmost and final portion, located in Beijing, China. During the Ming dynasty, the alteration of its northern starting point from Jishui Pond to Datong Bridge led to its widespread designation as the Datong Canal. It is a section of the Northern Canal water system and flows east-west, drawing on the water supply from the spring-fed project in Beijing's West Mountain region. The excavation of the Tonghui Canal was primarily intended to facilitate the grain transportation system, and it functioned as a crucial grain transportation channel for more than six centuries (1292-1901).

Furthermore, the Tonghui Canal represented the complete interconnection of the entire Chinese canal system from north to south and resolved the transportation issue of grain from Tongzhou to Beijing, allowing grain and commodities that previously required land transit to be delivered directly to Beijing via waterway. This significantly reduced transportation expenses and enhanced efficiency, marking a pivotal milestone in the ancient water conservancy history of Beijing, which had profound effects on political stability, economic development, cultural exchange, and other aspects of the capital. Yet, beyond its technical and economic functions, the Tonghui Canal also served as a contested arena where state power, local interests, and environmental constraints collided, raising broader questions about how infrastructure shaped imperial authority.

Given the Tonghui Canal's location, directly connected to the capital Beijing, its grain transportation role highlights the complex political, economic, social, and environmental developments in the Beijing region during the Ming dynasty. Scholar Peng Yunhe has described its geographical location as a key strategic passageway in the Beijing–Tongzhou grain transport system.[2] It indicates that the Tonghui Canal's particular geographical position rendered it highly significant to the Ming dynasty rulers who placed their capitals there. However, between 1368 and 1528, the navigability of the Tonghui Canal experienced considerable fluctuations, with periods of inactivity far exceeding those of operation. The interruptions and rehabilitations of the Tonghui Canal's navigability significantly influenced the Beijing region. Additionally, its functional status strongly impacted the stability of the central government and the effectiveness of local administration. Moreover, as an essential route for grain transportation, material exchange, and a spatial medium for the interaction between governmental authority and local interest groups, the Tonghui Canal reflected the underlying structures and practical principles of water management and socio-political culture throughout the Ming dynasty. This fluctuation was not a minor technical issue but a structural challenge that revealed the fragility of Ming governance, the limits of hydraulic technology, and the tensions within the empire's administrative order.

The development of the Tonghui Canal, as one notable instance of hydraulic engineering from the Ming dynasty, distinctly illustrates the various relationships among technological, economic, political, and social influences on the Beijing region at that time. The Tonghui Canal underwent a multifaceted historical transformation throughout the Ming dynasty. More importantly, it demonstrates the strategic significance that infrastructure served

in state governance. The navigability of the Tonghui Canal, a vital component of the grain transportation system to the imperial capital Beijing, fluctuated based on multiple variables, including the central government's capacity, political motivations, local administrative efficiency, and environmental conditions. Thus, the problem this study addresses is not only how and why the canal's navigability fluctuated, but also what these fluctuations reveal about the mechanisms of Ming statecraft and the interplay between infrastructure and political authority. The history of the Tonghui Canal exemplifies the evolution of hydraulic technology and serves as a significant empirical case for understanding how the Ming dynasty employed infrastructure to achieve political cohesion and social regulation. The strategic significance of the Tonghui Canal has also been emphasised by Zhang Xiaomei and Ku Boon Dar, who contend that its maintenance was closely linked to the political and economic priorities of the Ming state. In another study, the same authors further argue that Wu Zhong's rehabilitation of the Tonghui Canal illustrates the pivotal role of governance in overcoming hydraulic and administrative challenges. Their findings suggest that the canal's operation depended not only on engineering solutions but also on effective state intervention and institutional coordination. Therefore, a thorough and systematic examination of the fluctuating navigation of the Tonghui Canal during the Ming dynasty holds significant scholarly value. For historians, it offers a lens to interrogate state-society relations, centre-periphery dynamics, and the environmental dimensions of governance; for the field of historical scholarship, it contributes to comparative debates on how premodern states harnessed infrastructure as a tool of power. As Zhang Zhiyu and Mahani Musa argue, these developments should be situated within a broader process of state-led reconstruction that extended beyond physical infrastructure to encompass cultural and administrative institutions.[3]

This study aims to conduct a comprehensive analysis of the grain transportation dynamics and state governance relating to the Tonghui Canal during the Ming dynasty, focusing on several critical factors behind its interruptions, water shortages, technical challenges in hydraulic engineering, the intricate power dynamics between water-based and land-based transportation interest groups, and the issues of coordination among various administrative departments. All of these factors are examined to reveal the underlying historical causes of the interruptions in the navigation of the Tonghui Canal. As Farish A. Noor observes in a different historical context, systems of governance were often sustained through the production and management of knowledge, a pattern that is likewise evident in the administration of the Tonghui Canal.[4]

This study begins with an examination of Beijing's role as the political centre of the Ming dynasty in relation to the restoration of navigation, analysing how rapid population growth resulted in increased material demand, and how rising transportation costs for large-scale goods from the Jiangnan region to the capital drove the Ming central government to reevaluate and enhance the transportation system, ultimately leading to the reopening of the Tonghui Canal. Hence, this study focuses on systematically tracing the historical trajectory of the Tonghui Canal's variable navigational status by synthesising various aspects. It provides a thorough analysis of the Tonghui Canal's essential function as a grain transportation centre and demonstrates how its operational development mirrors the complex interaction of political, economic, social, and environmental factors in Ming dynasty Beijing. By reframing the Tonghui Canal as both a logistical artery and a political instrument, this study highlights why its fluctuating navigability matters not only for reconstructing Ming history but also for understanding broader patterns of governance in premodern empires.

The results of this study offer significant insights and serve as a solid foundation for subsequent research in related fields.

Literature Review

Research on the historical dynamics of grain transportation and state governance along the Tonghui Canal during the Ming dynasty, particularly concerning infrastructural interruptions and subsequent reconstruction, has developed into a comprehensive analytical framework. This research predominantly examines the subject through several key perspectives, including historical background, the canal's developmental progression, regional societal changes, and advancements in hydraulic engineering technologies.

In particular, studies on water sources and hydraulic engineering have been significant. Scholars such as Cai Fan have examined changes to the Ming Tonghui Canal's water sources and the reconstruction of Kunming Lake. This line of research explores the impact of Kunming Lake's transformation on the water sources and transportation capacity of the Tonghui Canal, with a focus on water supply and improvements to its transportation function. This perspective clarifies the influence of the canal's hydraulic system on its overall efficiency. However, this research reveals certain limitations. For instance, while it explains canal operations, it does not examine institutional arrangements, policy orientations, or socio-structural shifts. Moreover, although the technical analysis is rigorous, it overlooks political, economic, and social factors, thereby limiting its explanation of the canal's operational fluctuations. Similarly, the study by Chen Xibo and Deng Hui analyses Wu Zhong's 1528 rehabilitation of the Tonghui Canal and the revision of its watercourse layout. Though it highlights the spatial relationships between the canal and Tongzhou city, it does not address the Tonghui Canal's historical development in terms of technical characteristics, implementation procedures, and watershed governance logic. In addition, Hou Renzhi noted the implications of a series of spatial pattern changes for the historical evolution of the Tonghui Canal, which occurred during the construction of the Forbidden City and the expansion of the Imperial City, enclosing the old course of the Tonghui Canal within the inner city. Nevertheless, this research focused primarily on alterations in the Beijing segment of the Tonghui Canal and omitted consideration of its remaining sections.

More recently, broader studies of China's canal systems have expanded the analytical scope beyond individual engineering projects. Tan et al. examined the Grand Canal from a technical historical perspective and emphasised the importance of water source management, transport administration, hydraulic infrastructure and engineering innovation in sustaining long-distance navigation. Their study identifies the Tonghui Canal as one of the most significant achievements in water-resource planning within the Beijing-Hangzhou Grand Canal system.[5] Nevertheless, the emphasis remains predominantly on engineering and technical management, while the interaction between canal operation, state governance, and socio-economic change receives comparatively limited attention.

Likewise, Huang et al. investigated the relationship between the Grand Canal and the rise and decline of Kaifeng, demonstrating that canal systems served not only as transportation corridors but also as catalysts for urbanisation, commercial expansion, agricultural development, and regional integration. Their findings suggest that changes in canal routes and water-supply systems could fundamentally alter the prosperity of cities and regions.[6] However, the study focuses on the macro level impact of canal networks and provides limited analysis of

the operational mechanisms, interruptions and reconstruction processes of individual canals such as the Tonghui Canal.

From a historical geographical perspective, Shi argues that canal systems should be understood as dynamic geographical infrastructures shaped by the interaction of environmental conditions, human activities, political authority and economic development. Rather than treating canals solely as hydraulic projects, Shi interprets them as products of long-term geographical transformation and state intervention. This perspective broadens the understanding of canal development within wider historical processes.[7] Nevertheless, the study primarily examines the overall evolution of China's canal network and does not specifically analyse the historical dynamics of grain transportation, infrastructural interruptions and reconstruction along the Tonghui Canal during the Ming dynasty.

In examining the historical background of the Tonghui Canal's reopening during the Ming dynasty, scholars such as Gao Shouxian have investigated the canal's restoration in detail. His article analyses the political and hydrodynamic conditions surrounding the Tonghui Canal's 1528 restoration, drawing on an extensive body of historical documentation, and sheds light on the factors that enabled the canal's rehabilitation. This research's source collection and problem-focused methodology are promising, although many of the findings require further scholarly discussion. Nevertheless, this research has certain limitations. Its analysis focuses exclusively on the canal's reopening in 1528, while ignoring earlier shifts in the historical dynamics of grain transportation during the Ming dynasty. Consequently, the understanding of the canal's full operational cycle remains insufficient. Likewise, Xin Gongxue utilised the 1528 rehabilitation project of the Tonghui Canal as a case study, examining the historical progression of the Ming dynasty's initiative to re-dredge the canal. Notwithstanding, this research lacks a depiction of the complete Ming historical dynamics of the Tonghui Canal. Consequently, it does not accurately reflect the canal's long-term development in response to changing political, technological, and environmental challenges across different periods in history.

Scholars such as Hu Kecheng have examined the canal labourers of the Tonghui Canal in 1528 and highlighted the historical debates between the Ming court and the general population, debates that were triggered by the contemporaneous promotion and development of the canal's re-dredging and the redirection of the Sanli River. This perspective helps explain the contradictions between state-driven hydraulic projects and societal reactions, thereby enhancing the study of the Tonghui Canal infrastructure's social effects throughout the Ming dynasty. But this research fails to explain the Tonghui Canal's repair within a larger historical context. Thus, it does not capture the canal's multifaceted history or provide a longitudinal examination of its operational causes and administrative shifts over the Ming dynasty.

The existing scholarship has significantly advanced the understanding of the historical development of the Tonghui Canal. Nevertheless, several important gaps remain.

First, most studies draw on a relatively limited range of historical sources and seldom integrate official histories, local gazetteers, memorials, archival documents and engineering records within a unified analytical framework. Consequently, the broader historical context of grain transportation along the Tonghui Canal remains insufficiently reconstructed.

Second, existing research primarily provides descriptive accounts of canal construction, maintenance, and restoration, while paying comparatively less attention to the factors shaping the operation and disruption of grain transportation. As a result, the causes of transport interruptions, the processes of rehabilitation and their broader historical significance remain inadequately explained.

Third, much of the literature examines the Tonghui Canal from specific perspectives, including hydraulic engineering, water management, urban development, and restoration projects. Although valuable, these studies rarely situate the canal within the wider political, economic, and administrative framework of the Ming dynasty. Consequently, its role in state governance, the grain tribute system, and regional integration remains insufficiently explored.

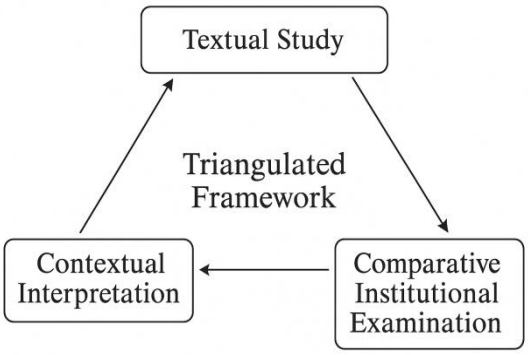
Finally, limited attention has been devoted to the interaction between environmental conditions, technological adaptation, and state intervention in shaping the canal's long-term development. Existing scholarship has yet to provide a comprehensive explanation of how these factors collectively influenced the continuity, disruption, and transformation of grain transportation throughout the Ming dynasty.

This study addresses these gaps through a systematic examination of the historical factors underpinning the development of the Tonghui Canal's grain transport function. It seeks to elucidate how the interplay of political, economic, technological and environmental factors, together with changing patterns of state governance across different phases of the Ming dynasty, shaped the evolution of the canal's transportation functions.

Research Methodology

This study employs a historical-analytical approach based on the examination of primary sources and historiographical synthesis. The fundamental methodology comprises a triangulated framework that integrates meticulous textual study, contextual interpretation, and comparative institutional examination (Figure 1). Rather than merely cataloguing sources, the triangulated design is deliberately chosen to move from documents to interpretation, ensuring that textual evidence is read not only at face value but through its political, institutional, and environmental contexts. The primary sources include the Gazetteer of the Tonghui Canal,[8] the Revised Gazetteer of the Tonghui Canal,[9] Ming dynasty imperial records such as the Veritable Records of the Ming dynasty,[10] the History of the Ming Dynasty[11] and local gazetteers from Beijing, Tongzhou (located in southeast Beijing) and surrounding jurisdictions. These were supplemented by Ming administrative maps and hydrological data from canal archives. These sources were prioritised because they directly reflect the administrative, technical, and logistical concerns of the Ming state, thus aligning most closely with the research questions on grain transport and governance. This study delineates the historical development of the Tonghui Canal during the Ming dynasty by integrating primary sources such as stone inscriptions and imperial memorials with pertinent contemporary research related to the canal. In this way, the methodology connects documentary traces with analytical questions, demonstrating how shifts in textual emphasis mirror broader transformations in governance and hydraulic management.

Figure 1: Schematic Diagram of the Triangulation Framework



Sources: Miles, M. B. and Huberman, A. M. *Qualitative data analysis: an expanded sourcebook* (2nd ed). California: SAGE Publications, Inc., 1994, p. 18.

This study uses dialectical analysis to evaluate historical sources by emphasising the interrelationship between historical events and their temporal circumstances, in order to uncover the intricate causal mechanisms and power dynamics underlying the canal's continual periods of decline and reconstruction. Dialectical analysis is particularly suited here because it reveals how official rhetoric, material constraints, and political priorities interacted to shape policy outcomes, rather than treating sources as neutral records. It seeks to illustrate the complex political, economic, social, and cultural dynamics that regulated the Tonghui Canal, thereby transcending linear narratives and providing fresh illumination on Ming dynasty water management and governance. It employs dynamic textual analysis to understand the logic behind the Tonghui Canal's grain transportation dynamics and state governance, while also examining institutional tensions and social controversies across different historical stages. In addition to rhetorical structures and linguistic methods, this study considers intended audiences, political-economic stakes, and outcomes, including imperial endorsement or rejection. By doing so, the methodology makes explicit how analysis progresses from the language of memorials and gazetteers to broader interpretations of institutional resilience and political negotiation. This multifaceted approach presents memorials as strategic texts embedded within the Ming dynasty's bureaucratic political culture, reflecting debates and compromises among competing interest groups.

This study also employs historiographical tools to critically examine the deeper historical causes of the Tonghui Canal's grain transportation dynamics and state governance during the Ming dynasty. It analyses the structural patterns and editorial logic of local gazetteers, compares them with Ming dynasty canal-related materials, and interprets them in light of specific historical events to reveal their historical significance. This study also makes use of dynastic histories such as the History of the Yuan Dynasty[12] and History of the Qing Dynasty[13] to situate Ming-era developments of the Tonghui Canal within a broader historical context. This longitudinal study examines the institutional changes related to grain transportation dynamics, state governance, and regional administration of the Tonghui Canal throughout the Ming dynasty.

This study was limited by the incomplete nature of many primary documents and by the historiographical biases present in official compilations. Rather than treating these biases as obstacles alone, the analysis incorporates them as objects of study, asking how omissions, emphases, and silences in Ming official records reflect underlying ideological and political agendas. These gaps were addressed through cross-validation with alternative sources, including administrative documents, personnel logs, and contemporaneous remarks from officials in the Beijing region, wherever feasible. This reflexive treatment of source bias strengthens the analytical framing by demonstrating how the very distortions of official records can illuminate contested spaces of governance and authority. By integrating textual, technical, and spatial data, this study develops a comprehensive understanding of the Tonghui Canal's grain transportation dynamics and governance, grounded in verifiable historical evidence and attentive to the predominant ideological and administrative developments of the period.

The Historical Dynamics of the Tonghui Canal during the Ming Dynasty

The Tonghui Canal, a fundamental hydraulic project in the grain transportation system of imperial Beijing, exemplifies the advancement of water engineering technologies and illustrates the intricate relationship between state governance and regional development projects. The navigability of the Tonghui Canal depended on Beijing's political status and economic requirements, including the central government's financial resources, policy direction, and local administrative efficiency. Therefore, the Tonghui Canal serves not only as a subject of hydraulic history but also as a vital standpoint for analysing imperial Beijing's utilisation of infrastructure to accomplish unity of purpose, economic coordination, and social governance. Framing the canal in this way allows us to move beyond a descriptive chronology and to interrogate how fluctuations in navigability expose both the strengths and vulnerabilities of Ming statecraft.

This study examines the developmental process of the Tonghui Canal during the Ming dynasty, delineating its history into three distinct periods based on significant historical events directly linked to the canal, and analysing the grain transportation dynamics and state governance that occurred during each phase. This periodisation is determined by notable historical events that influenced the reconstruction of the Tonghui Canal. Rather than presenting these as neutral intervals, the periodisation is analytically useful: it highlights how shifting political priorities, economic pressures, and hydraulic capacities shaped the functioning of the canal, thereby revealing the interplay between infrastructure and governance. It is essential, as it highlights the transformations in political leadership, shifts in economic objectives, and progress in hydraulic engineering methods that shaped the transportation and administration of the canal over time.

The first period was the early stage (1368-1441, 73 years). This periodisation is fundamentally grounded in the fluctuating political role of Beijing as the imperial capital and its direct influence on the grain transportation dynamics and state governance of the Tonghui Canal.[14] This stage demonstrates how debates over the capital's location directly translated into the canal's operational uncertainty, underscoring the canal's dependence on imperial political will.

The second period was the middle stage (1441-1528, 87 years). This periodisation focuses on the continuous oversight of the Tonghui Canal in line with Beijing's developing status as

the imperial capital. During this timeframe, successive Ming rulers ordered the reexcavation and extensive dredging of the canal. Under the Chenghua reign (1465-1487), the Tonghui Canal attained nearly two years of navigability. Nevertheless, due to enduring constraints such as water scarcity, technological obstacles, conflicts among interest groups, and administrative inefficiencies, long-term, reliable transportation was never fully achieved. [15] This stage illustrates the paradox of state capacity: while the Ming state could mobilise large-scale dredging, it failed to overcome structural constraints, showing the limits of imperial engineering in the face of environmental and institutional challenges.

The third period was the late stage (1528-1644, 117 years). Spanning from 1528 to the end of the Ming dynasty, it began with the successful rehabilitation of continuous transportation in 1528, marking a period during which the Tonghui Canal fulfilled its designated function in the capital's grain transportation system. [16] However, as the Ming dynasty drew to a close, political corruption, budgetary disintegration, and the deterioration of water management institutions resulted in a renewed decline in the canal's navigability. This stage highlights how institutional decay eroded earlier achievements, turning the canal into a barometer of dynastic decline.

This chronological breakdown provides an understanding of the connection between the Tonghui Canal's grain transportation dynamics and state governance throughout history, as well as the intricate institutional and technical roles that infrastructure played within the Ming dynasty's administrative structure. By showing how each phase of the canal's history reflected broader shifts in imperial capacity and political economy, the study situates the Tonghui Canal as an analytical case through which to understand the relationship between infrastructure and authority. It offers significant explanatory insight into the mechanisms through which the state pursued political integration, resource coordination, and social control, thereby contributing to broader theoretical discourse on the relationship between infrastructure and state authority in imperial China.

This dynamic periodisation paradigm facilitates a more accurate assessment of fluctuations in navigability and of the fundamental political, economic, and technical factors driving these adjustments. It not only enhances understanding of the Tonghui Canal's fluctuations but also provides fresh insights into the shifting political dynamics, evolving economic frameworks, and hydraulic innovations in the Beijing region across several historical periods. In this way, the Tonghui Canal becomes more than a local case: it provides a critical lens for historians to assess how infrastructure mediated the balance between environmental constraints and imperial ambitions.

Dynamics of the Tonghui Canal: Navigation, Grain Transportation, and State Governance

During the early and mid Ming dynasty (1368-1528), considerable upstream sections of the Tonghui Canal, including Baifu Spring, were neglected, leading to silting and obstruction along the entire transportation course of the canal.[17] Although from 1403 the Ming rulers engaged in significant negotiations and deliberations over the re-dredging of the Tonghui Canal to restore its transportation function, the dynasty subsequently launched numerous dredging projects along the riverbed at various intervals. These repeated but often ineffective efforts already

suggest a structural governance problem: imperial ambition collided with technical limitations and fragmented bureaucratic responsibility.

An analysis of the transportation conditions along the Tonghui Canal during this period demonstrates that grain transport frequently fluctuated between navigability and interruption. This study finds that the duration of interruptions in grain transport was markedly longer than the periods of effective navigation. This imbalance is not only a technical record but a reflection of how fragile state authority could become when infrastructure failed to meet political and economic demands. An in-depth investigation of the fundamental causes of this historical phenomenon indicates that multiple social factors, such as the political and economic context, the advancement of hydraulic engineering technology, and the fierce rivalry between water-based (transportation of grain via canal routes) and land-based (transportation of grain via overland routes) factions, significantly influenced the transportation conditions of the Tonghui Canal.[18]

From 1368 until 1528, the interruptions to grain transport along the Tonghui Canal were marked by their prolonged duration and persistence. This study finds that the primary causes were attributable to the following factors: insufficient water sources; inadequate maintenance and governance following Beijing's decline in status as the capital; limitations in hydraulic engineering technology; and conflicts of interest between water-based and land-based groups. These issues show how environmental constraints, institutional weaknesses, and competing economic interests intersected to undermine canal stability. The central concern, which emerged between 1620 and 1644 was political corruption.[19]

The first factor was the serious decline in water supply. Between 1368 and 1528, the principal cause was the lack of maintenance of the upstream section of the Tonghui Canal, which led to an insufficient water supply. The second cause of water source depletion was largely associated with the construction of the Ming Tombs in 1409, which resulted in the upstream section of the Tonghui Canal being legally declared a restricted area, thereby strictly prohibiting any water diversion activities. As noted by Gao Shouxian, from that time onwards proposals to utilise water from Baifu Spring were dismissed by geomancers, who argued that the water in front of the Ming Tombs should not be diverted upstream.[20] Furthermore, the section below Jishui Pond was simultaneously diverted by the Dam River, further diminishing the water volume of the Tonghui Canal. Despite efforts to restore the canal's transportation system during the Yongle period (1403-1424), these attempts proved ineffectual due to human factors. Chief among these were the prohibition on utilising the primary water source, Baifu Spring, which resulted in persistent water scarcity, and the broader problem of water shortage was intricately linked to environmental degradation caused by significant deforestation in the Beijing region during that period. This was particularly associated with urban development in Beijing, including the extensive reconstruction of the imperial palace, the construction of official residences, and the establishment of housing for the general population, all of which required substantial quantities of lumber.[21] According to Ma Wensheng's memorial, particularly from the mid-Ming dynasty onwards, the official residences in the Beijing area underwent significant renovations, resulting in the continual construction of large and luxurious buildings.[22] As indicated by the aforementioned data, urban development has resulted in extensive deforestation in the regions surrounding Beijing, leading to a sustained decline in forest coverage. Moreover, this process was further exacerbated by the climatic conditions associated with the Little Ice Age. Collectively, these factors contributed to the gradual depletion of water sources, increased siltation, and the deterioration of the Tonghui

Canal's transport capacity. Thus, environmental stress combined with cultural restrictions (geomancy and tomb protection) shows how ideology and ecology together constrained hydraulic policy.

The issue of hydraulic engineering was substantial. The primary factor influencing the navigability of the Tonghui Canal was the challenge of resolving the geographical elevation disparity through hydraulic engineering technology. Owing to a height difference of about 6 *zhang* [23] between Beijing and Tongzhou, the canal's gradient was nearly one in 1,200. The steep elevation of the Tonghui Canal caused the water to flow too rapidly to be effectively controlled. For instance, efforts to rehabilitate the Tonghui Canal between 1442 and 1443 were unsuccessful. The underlying reason was that key challenges in hydraulic engineering were not adequately addressed: the northwest of Beijing is at a high elevation, and the topography from Datong Bridge to Tongzhou resembles water descending from a great height. Mandating dredging under such conditions was not merely futile but also potentially catastrophic.[24] This finding highlights the limitations of Ming technological capabilities, as large-scale mobilisation of resources and labour was unable to overcome the absence of effective engineering solutions for water level and gradient management.

The conflicts of interest between water-based and land-based groups were complex. Various stakeholders competed for transportation resources and market shares, with the fundamental cause rooted in the intense rivalry between these two interest groups. This study demonstrates that, from 1441 to 1527, the land-based transportation faction posed a significant challenge to the uninterrupted operation of the Tonghui Canal, gradually attracting greater attention from Ming dynasty rulers, as evidenced by an analysis of historical documents. The *Ming Xiaozong Shilu* (Veritable Records of Emperor Xiaozong of the Ming Dynasty) supports this through a memorial submitted by Xu Ang, [25] the Supervising Secretary of the Ministry of Revenue. [26] He proposed the rehabilitation of the road extending from east of Datong Bridge to west of Zhangjiawan for grain transportation and recommended replacing the gatekeeper at Qingfeng Sluice with personnel tasked with road maintenance. His proposition was subsequently endorsed by the rulers of the Ming dynasty. [27] Upon reviewing previous historical data and associated assessments, it is evident that the Ming dynasty prioritised land-based transportation during this period. This policy bias was a direct cause of the Tonghui Canal's long-term interruptions in grain transport, especially when contrasted with the ineffective support and general neglect of water-based transportation networks. Moreover, as Hu Kecheng observes, human factors played a crucial role: influential communities and land-based transportation interest groups, among other vested interests, consistently obstructed the rehabilitation of the Tonghui Canal.[28] This rivalry shows how canal policy was shaped as much by factional lobbying and vested interests as by technical considerations, underlining the political economy of infrastructure.

This study reveals that the power struggle between interest groups representing water-based and land-based transport factions significantly influenced the situation of the Tonghui Canal, as demonstrated by an analysis of the historical context. Particularly noteworthy were influential social organisations, land-based interest groups, and other stakeholders that obstructed the rehabilitation of the canal in pursuit of their own objectives. Profit-driven interventions not only hindered the restoration and development of essential infrastructure but also exposed the profound structural tensions and conflicts between public interest and private gain in the policy making process of the time.[29] According to the *Ming Xiaozong Shilu*, from 1620 until the end of the Ming dynasty, corruption within the political system escalated, leading

to protracted decision making and indecisiveness that hindered the prompt and effective execution of dredging and other governance related operations on the Tonghui Canal.[30] In short, the breakdown of the infrastructure system cannot be attributed solely to technical failures rather, it was deeply embedded in the political culture of the Ming dynasty, shaped by factional rivalries, administrative inefficiencies and corruption.

Additionally, conflicts and inconsistencies among the management agencies constituted a significant factor. During the early and mid Ming dynasty (1368-1528), the administrative system of the Tonghui Canal was characterised by a proliferation of bureaucratic agencies that frequently engaged in disputes over its governance and maintenance, thereby impeding effective administration. Moreover, eunuch troops exerted substantial influence over the operations of the Tonghui Canal. They frequently intervened in its governance for personal or political gain, leading to dredging and maintenance activities that not only reflected the competing interests and coordination challenges among various departments of the Ming state but also underscored the complex interplay between imperial authority and the civilian bureaucracy. The outcomes of these interventions were the result of continual negotiation among multiple stakeholders and were significantly shaped by shifting power dynamics. The study finds that disruptions to grain transport along the Tonghui Canal during the Ming dynasty were caused by several interrelated factors, including water shortages, technological constraints in canal engineering, competition between water and land transport interests, and political corruption. These interrelated elements collectively hindered efforts to restore uninterrupted transportation along the canal. The Tonghui Canal thus functioned as a microcosm of Ming governance, where environmental, technological, and institutional constraints exposed the fragility of state power.

Following the Tonghui Canal's restoration in 1528, a systematic management framework and the creation of dedicated management positions facilitated timely dredging and maintenance, thereby ensuring its continued navigability during the Ming dynasty. From this point onwards, the strategically significant role of the Tonghui Canal as a crucial link between Beijing and Tongzhou, with both political and economic value, steadily emerged.

Between 1368 and 1528, multiple efforts were made by the Ming rulers to rehabilitate the Tonghui Canal's grain transportation function. Between 1476 and 1478, the canal was intermittently restored for grain transport, but inadequate management and maintenance led to a subsequent and prolonged cessation of operations. As Gao Shouxian has noted, it was not until 1528 that the Tonghui Canal was successfully rehabilitated for grain transportation, since nearly all earlier attempts had ended in failure.[31] Nonetheless, these endeavours yielded significant expertise that contributed to the effective rehabilitation and sustained transportation of the Tonghui Canal in 1528. The failure–success trajectory of these projects shows how accumulated technical knowledge, combined with institutional reform, eventually overcame earlier blockages, marking 1528 as a watershed moment in Ming canal governance.

This study provides a systematic assessment and thorough analysis of the development and evolution of transportation along the Tonghui Canal throughout a designated historical period. The findings demonstrate that the canal significantly influenced the political, economic, social, and environmental transformations in the Beijing region during the Ming dynasty. This study identifies two key characteristics directly associated with the rehabilitation of grain transportation on the Tonghui Canal during the Ming dynasty.

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One of the primary characteristics was the political situation of Beijing. As recorded in the *Ming Xizong Shilu*, Beijing's status as the capital throughout the Ming dynasty underwent multiple alterations. [32] An in-depth analysis of the Ming administration's governance and focus on the Tonghui Canal during both Beijing's periods as the capital and as a non-capital demonstrates the canal's heightened significance when Beijing served as the imperial capital. Table 1 outlines the distinct historical periods during which Beijing functioned as the capital, thereby effectively illustrating the progression of its significance as the political centre. The Tonghui Canal was closely linked to the development and functioning of the Ming capital. Its history offers valuable insights into the relationship between infrastructure, state governance, and imperial power during the Ming period.

Table 1: Beijing's Tenure as the Ming Dynasty Capital and Non-Capital

Year	Capital	Non-Capital
1368-1420	-	√
1421-1424	√	-
1425-1440	-	√
1441-1644	√	-

Note: A check mark (✓) indicates whether the period corresponds to Beijing serving as the capital; absence of a mark denotes its status as a non-capital.

Sources: Zhang Tingyu, *Ming Shi – Dili Yi (History of Ming– Geography I), 明史 - 地理一*, Vol.40, Beijing: Zhonghua Book Company. Reprint, 1974, p. 881, 883, 884.

This study demonstrates that a comparative analysis of the data in Table 1 and the developmental status of the Tonghui Canal during analogous historical periods reveals that the canal's historical evolution in the Ming dynasty was closely associated with Beijing's status as the capital. Furthermore, by examining Beijing's political status as both capital and non-capital during various phases of the Ming dynasty, one can clearly observe the transformation of the Tonghui Canal's transportation conditions, thereby demonstrating the intrinsic relationship between grain transportation and Beijing's political status. This confirms that fluctuations in the canal's navigability were not isolated technical episodes, but structural consequences of political decisions tied to the fate of the capital itself. For example, following the official relocations of the capital to Beijing in 1421 and 1441, respectively, and the rehabilitation of transportation in 1528, the Tonghui Canal as a crucial waterway linking Beijing and Tongzhou, was indispensable in securing the supply of grain and goods to the capital and in fostering economic development.[33]

Examining Beijing's status as both capital and non-capital throughout Ming history demonstrates that political changes directly affected Tonghui Canal transportation. In particular, from 1368 to 1402, when Beijing was not yet the national capital, the Tonghui Canal

experienced frequent service delays, and transportation records were scarce except for military requirements. According to the *Ming Xizong Shilu*, when the Ming dynasty designated Beijing as its capital in 1403, the canal's strategic significance increased markedly. Beginning in 1406, with the massive construction of the Forbidden City and other royal architectural complexes, the demand for building materials and supplies grew substantially, drawing the ruler's attention to the Tonghui Canal.[34] For example, in 1407 and 1412, the Ming dynasty undertook extensive restoration of the Tonghui Canal. This demonstrates the dynasty's commitment to the canal's development and the substantial impact of Beijing's political status on its historical dynamics. Following the official relocation of the capital to Beijing in 1421, the Tonghui Canal became an essential waterway linking Beijing and Tongzhou. The transportation of grain and other commodities along this route was vital to the capital's development and stability, particularly after 1528. This linkage highlights how infrastructural choices were not only reactive to immediate needs but part of a broader strategy of consolidating imperial authority in the new capital. As Hu Kecheng's research shows, the successful rehabilitation of the Tonghui Canal resolved a persistent problem that had plagued rulers during the early and mid Ming dynasty. Upon completion, the annual savings in transportation costs and associated charges exceeded 100,000 taels of silver. [35]

Moreover, this study demonstrates that the Tonghui Canal received greater attention when Beijing served as the capital. For instance, during Beijing's tenure as the capital, the Ming dynasty maintained the canal by ensuring its protection and continued availability. It is evident from the Tonghui Canal's grain transportation conditions prior to 1528 that the dynasty's focus and dedication in administering the canal fluctuated in accordance with Beijing's status as the capital. This indicates that political considerations heavily influenced the management of the Tonghui Canal. The case demonstrates that infrastructure development in premodern states was closely connected to the political and administrative functions of capital cities, where the demands of governance, economic management, and state authority intersected.

A close relationship existed between the Tonghui Canal's role in grain transportation and Beijing's political prominence as the Ming dynasty's capital. Both were interdependent and reflected the broader fluctuations of Ming history. The rise and decline of the Tonghui Canal represent not only the Ming dynasty's grain and commodities transportation system but also the wider impact of governmental decisions on water transportation and the political economic order. In this sense, the Tonghui Canal becomes an analytical lens to study how Ming rulers leveraged, neglected, or restructured infrastructure in response to shifting political economies.

The decision to restore the Tonghui Canal was significantly influenced by economic concerns. After the Ming relocated its capital to Beijing, the extravagant expenditures of the Ming court, along with the salaries of officials and soldiers, became major factors driving the demand for grain transportation. The central governing institution of the Ming dynasty was vast and complex, forming what has been described as a large parasitic system. For example, according to the Ming dynasty's salary system, royal family members, including princes, princesses, junior princes, and their children, received annual grain allowances ranging from 50,000 to 500 *dan*, [36] depending on their rank. This indicates that the expenditure on grain allowances for the royal family alone far exceeded the annual regular grain supply available to Beijing. Thus, the fiscal drain of elite maintenance transformed the Tonghui Canal into a

lifeline for the dynasty's survival, illustrating how infrastructural policy was deeply tied to elite consumption and court politics.

Moreover, after the Ming dynasty relocated its capital to Beijing, according to Han Guanghui and Cao Shuji's study, the population in the Beijing region experienced a rapid increase. From the Hongwu period (1368-1369, when the population in the Beijing area was approximately 100,000) [37] to the Jiajing period (1522-1566, when it reached 1.2 million),[38] the population size of Beijing increased twelvefold. According to scholar Han Guanghui,[39] by 1587, the population had reached 1.85 million.

In addition, the total number of garrison troops reached over 500,000 during the Yongle reign (1403-1424). The number of palace attendants and eunuchs who directly served the daily life of the imperial family was approximately 5,000 before the Zhengtong reign (1436-1449), but by the mid to late Ming dynasty (1528-1644) this figure had risen to about 15,000. This considerable demographic growth posed a major challenge to the capital's material supply system, significantly complicating the assurance of material provision. Furthermore, considering that material productivity in the Beijing region during that period was severely constrained, production was inadequate to meet the fundamental needs of its substantial population, with supplies of grain and essential goods heavily dependent on Southern China. Therefore, the Tonghui Canal's importance was undeniable. The demographic surge magnified the infrastructural bottlenecks, making the canal's navigability not just an economic issue but a central determinant of dynastic stability.

Hence, with Beijing as the capital, its requirement for material resources increased substantially, as evidenced by the preceding analysis and associated historical data. These materials were predominantly delivered via transportation from the southern regions. Thus, the expense of transporting grain and goods from the south represented a considerable financial burden. According to the *Ming Shizong Shilu*, prior to the reopening of the Tonghui Canal, southern grain boats were restricted to docking at Zhangjiawan, necessitating the hiring of carts and porters to deliver a portion of the grain overland to Beijing, thereby imposing a significant economic strain on the fiscal revenue of the Ming dynasty. [40]

The transportation costs between Beijing and Tongzhou were prohibitively high, nearly equalling the costs of transporting commodities from the south to Tongzhou. Yuan Huang's memorial states that the grain transportation route from Suzhou and Songjiang to Zhangjiawan via the canal extended over 3,700 *li,* [41] although the overland trip from Tongzhou to Beijing was only 60 *li.* Yet the transportation costs for both routes were almost equal. He argued that the navigability of the Tonghui Canal could provide significant economic value. [42] This comparison highlights the irrationality of overland reliance and explains the strong policy impetus for the canal's rehabilitation.

According to the *Ming Shizong Shilu* records, the considerable financial benefits of rehabilitating the Tonghui Canal served as the primary motivation for the Ming authorities to consistently submit memorials in support of its restoration for grain transportation purposes. Following the successful rehabilitation of the canal in 1528, [43] the cost of transporting grain that year was only 7,000 taels of silver, [44] while the total grain transported to Beijing via the Tonghui Canal amounted to 1,993,800 *dan,* resulting in savings of over 113,300 taels[45] in transportation costs for the dynasty. In other words, the rehabilitation of the Tonghui Canal alone yielded annual savings of more than 100,000 taels in transportation costs. Additionally,

the canal's rehabilitation facilitated the direct delivery of grain, supplies, and commodities from the southern regions to Beijing. This transformation not only reduced transportation time, curtailed expenses, and accelerated the movement of goods but also fostered commodity exchange and commercial prosperity between Beijing and Tongzhou. Thus, the Tonghui Canal functioned simultaneously as an economic artery and as a tool of fiscal consolidation, deepening our understanding of how infrastructure underpinned state survival in late imperial China.

Moreover, with the steady growth of water-based transportation and the circulation of commodities, the Ming dynasty's fiscal revenues experienced a major increase. Grain and commodities, constituting significant sources of taxation, boosted national treasury income owing to heightened transportation efficiency. As noted by Hu Mangquan, the rehabilitation of the Tonghui Canal significantly contributed to economic development in the Beijing region. It strengthened Beijing's position as a major economic centre in northern China and stimulated broader economic growth during the Ming dynasty. [46] Taken together, these developments show that the Tonghui Canal was not merely a hydraulic project but a central axis where political authority, economic capacity, and infrastructural technology intersected, making it a model case for analysing state power in Ming China.

Conclusion

This study examines the interruption and restoration of the Tonghui Canal during the Ming dynasty within the broader context of state governance and water management. The findings indicate that a range of structural challenges affected the stability of the canal system. Water shortages reflected both environmental constraints and human intervention, technological limitations reduced transport efficiency, competing interests among transport stakeholders generated social tensions, and political corruption weakened institutional effectiveness. The study further demonstrates that Beijing's status as the imperial capital, together with the central government's concern for securing a stable supply of resources to the city, constituted the principal driving forces behind the reconstruction and continued maintenance of the Tonghui Canal.

The Tonghui Canal played a vital role in grain transportation and state governance during the Ming dynasty, exerting a significant influence on the political, economic and social development of the Beijing region. This study critically examines a wide range of historical sources to analyse changes in the canal's transport functions and governance roles, with particular attention to the political, economic, social, technological and environmental factors that shaped these developments. The wider implications of these transformations for regional society are also explored.

The findings contribute to a deeper understanding of the relationship between hydraulic management, state governance and economic development in Ming China. It also offers valuable historical perspectives on water resource management by highlighting the importance of coordinated governance, institutional effectiveness, and informed policy decisions in maintaining large-scale infrastructure systems. At the same time, the case of the Tonghui Canal reveals the limitations of the Ming state's capacity. Although successive rehabilitation efforts improved the canal's operation, many underlying structural challenges remained unresolved,

leaving the system vulnerable to recurring disruptions and long-term instability. This suggests that state intervention alone was insufficient to guarantee the long-term stability of hydraulic infrastructure when environmental constraints, technological limitations and institutional weaknesses remained unresolved.

It demonstrates that the Tonghui Canal's historical fluctuations were not attributable to a single cause but rather emerged from a confluence of structural difficulties. Primary factors included severe water shortages, limitations in hydraulic engineering technology, conflicts between water-based and land-based interest groups, and widespread governmental corruption, all of which reduced the Tonghui Canal's transportation capacity. In contrast, the reinstatement of Beijing as the imperial capital, together with its enhanced political significance and considerable economic requirements, constituted the principal motivators for the Tonghui Canal's rehabilitation as a transportation route. More importantly, these findings indicate that the operation of the Tonghui Canal was closely tied to the priorities of the Ming state. The canal's reconstruction was driven not merely by economic considerations but by broader concerns relating to political legitimacy, fiscal security and the maintenance of imperial authority in the capital region.

Rather than portraying the Tonghui Canal as a linear success story, this study highlights the fragility of its navigability and the contested nature of its governance. Its history illustrates both the ambitions of the Ming state to consolidate authority through infrastructure and the persistent challenges that undermined these ambitions. The evidence therefore, challenges interpretations that view hydraulic projects solely as demonstrations of state power. Instead, the Tonghui Canal reveals the extent to which state authority depended upon continual negotiation between environmental realities, technological capabilities, administrative effectiveness, and local interests.

This historical dynamic process emphasises the complex relationship between hydraulic infrastructure and state governance, while also illustrating the strategic importance of canal networks in urban development. Ultimately, the Tonghui Canal serves less as a symbol of uninterrupted achievement than as a reminder of the tensions between technological capacity, environmental limits, political ambition, and administrative resilience in premodern China**.** Its history further demonstrates that infrastructure functioned not only as a material foundation of governance but also as a critical indicator of the strengths and limitations of state capacity in responding to long-term structural challenges.

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Biodata

Dr. Zhang Xiaomei obtained her PhD in History from Universiti Sains Malaysia (USM), Malaysia. She is currently an independent researcher in China. Her research interests focus on the history of China's Grand Canal with particular emphasis on the Tonghui Canal.

*Dr. Ku Boon Dar (kubd@usm.my) (corresponding author) is a Senior Lecturer in the History Section, School of Distance Education, Universiti Sains Malaysia (USM), Malaysia. His research interests include Chinese history, Southeast Asian history, China-Southeast Asia relations and the historical interactions between China and the Malay World.

Notes

[1] Mohd, Firdaus Abdullah, Arbai'yah, Mohd Noor, "Sejarah Perkembangan Bekalan Air Domestik di Negeri Kedah Sehingga Tahun 1957," *Sejarah: Journal of History Department, University of Malaya*, Vol. 26, No. 2, 2017, pp. 24-37.

[2] Peng Yunhe's text states that excavating the throat of the Tonghui Canal, known as the 'Grain Transportation Canal of Dadu (Beijing),' facilitated the complete connection of the Grand Canal from Beijing to Hangzhou. The rehabilitation and strategic utilisation of the Datong Canal (Tonghui Canal), a vital channel for grain transportation to the imperial capital, was of considerable importance. [Original Chinese: 开凿'大都运粮河'的咽喉-通惠河, 贯通京杭大运河全程; 对京师漕运咽喉要道-大通河(即通患河)的修治利用.] Peng Yunhe, *Ming Qing Caoyun Shi (History of Water Transport in the Ming and Qing Dynasties), 明清漕运史,* Beijing: Capital Normal University Press, 1995, p.75, p.122.

[3] Zhang, Zhiyu and Mahani, Musa, "The Revival of Regional Museums as Keeper of Culture in Post-Mao China (1976-1978)," *Sejarah: Journal of the Department of History,* Vol. 32, No. 1, 2023, pp.145-165.

[4] Farish, A. Noor, "The Appendices of Empire: Why Writings from the Colonial Era Need to Be Read in Their Entirety," *Sejarah: Journal of the Department of History,* Vol. 31, No. 1, 2022, 18-33.

[5] Xuming Tan, Yunpeng Li, Jun Deng, Jinhong Wan and Jiangang Liu, *The Technical History of China's Grand Canal*, Hackensack, NJ: World Century Publishing Corporation, 2020, p. 47-80.

[6] Wenji Huang, Mingwang Xi, Shibao Lu and Farhad Taghizadeh-Hesary, "Rise and Fall of the Grand Canal in the Ancient Kaifeng City of China: Role of the Grand Canal and Water Supply in Urban and Regional Development", *Water*, Vol. 13, No. 14, 2021, pp. 1-21.

[7] Nianhai Shi, *A Historical Geography Research of Canals in China*, Singapore: Springer Nature Singapore, 2025, p. 6.

[8] *The Gazetteer of the Tonghui Canal* (通惠河志), written by Wu Zhong (吴仲) during the Ming dynasty, is a specialised historical document that records the development, hydraulic engineering, and transportation operations of the Tonghui Canal. It provides comprehensive accounts that highlight the canal's strategic importance in supplying grain to imperial Beijing. The Gazetteer also reflects the Ming dynasty's approaches to water management, fiscal coordination, and social governance, making it a valuable resource for examining the relationship between infrastructure and imperial authority.

[9] *The Revised Gazetteer of the Tonghui Canal* (重修通惠河志) compiled by Lu Jishu (陆基恕) during the Ming dynasty, is an expanded edition of the earlier *Gazetteer of the Tonghui Canal* first produced by Wu Zhong in the Jiajing era (1522–1566). Originally consisting of nine volumes, only about six survive today. The *Gazetteer* documents the dredging history of the Tonghui Canal from the Yuan to the Ming dynasties, covering official administrative frameworks, grain transportation management, engineering costs, and related literary records. It not only fills a critical gap in the documentation of water management during the Ming and Qing dynasties but also provides essential evidence for understanding the grain transportation system to the capital and the wider mechanisms of state control. This work holds considerable academic value for the study of Beijing's urban history, the Grand Canal, and the political and social structures of the Ming dynasty.

[10] *The Ming Shilu (Veritable Records of Ming,* 明实录) was an officially compiled historical record, arranged chronologically by the Ming dynasty administration. It systematically documents the political, military, economic, and social activities of fifteen emperors, from Ming Taizu Zhu Yuanzhang (明太祖朱元璋) to Ming Xizong Zhu Youjiao (明熹宗朱由校), with additional entries from the Chongzhen reign (崇祯). The *Ming Shilu* is an essential source for studying Ming political institutions, imperial authority, bureaucratic functions, and social change, and it holds significant historical and academic value for research on the Ming dynasty.

[11] *The History of Ming* (明史) is an important historical record that chronicles the rise and fall of the Ming dynasty. As one of the *Twenty-Four Histories of China* (二十四史), it serves as a crucial source for the study of Ming history.

[12] *The History of Yuan* (元史) is an important historical record that chronicles the rise and fall of the Yuan dynasty. As one of the *Twenty-Four Histories of China* (二十四史), it serves as a crucial source for the study of Yuan history.

[13] *The Draft History of Qing (Qing Shi Gao,* 清史稿*)* is the most comprehensive historical record of the Qing dynasty, preserving a wealth of valuable archival materials. It provides a detailed account of Qing rule from its establishment in 1644 to its collapse in 1912 following the Xinhai Revolution (辛亥革命). Covering a broad range of topics—including politics, military affairs, the economy, culture, ethnic policies, and foreign relations. It serves as an indispensable source for the study of Qing history.

[14] Zhang Tingyu, *Ming Shi - Dili Yi (History of Ming - Geography,* 明史 - 地理), Vol.40, Beijing: Zhonghua Book Company. Reprint,1974, p. 881, 883.

[15] Ibid., p. 884.

[16] Wu Zhong, Zhongguo Shuili Shi Dian - Yunhe Juan - Tonghuihe Zhi (Chinese Water History Classics: Canal Volume, Gazetteer of the Tonghui Canal), 中国水利史典 - 运河卷 - 通惠河志, Beijing: China Water & Power Press. Reprint, 2015, p. 225.

[17] Ibid., p. 178.

[18] Gao Shouxian. "Jianhao Zunao Yihuo Jishu Zhang'ai: Mingdai Xiufu Tonghuihe De Quzhe Guocheng (Obstruction by the Villains or Technical Obstacles - The Tortuous Process of Restoring the Tonghui Canal in the Ming dynasty), 奸豪阻挠抑或技术障碍: 明代修复通惠河的曲折过程", *Ming Dynasty National and Social Research Series*, No.11, 2013, p. 29.

[19] *Ming Xizong Shilu (Veritable Records of Emperor Xizong of Ming), 明熹宗实录*, Vol.7, Taipeh: Institute of History and Philology, Academia Sinica. Reprint, 1962, p. 335.

[20] Gao Shouxian. "Jianhao Zunao Yihuo Jishu Zhang'ai: Mingdai Xiufu Tonghuihe De Quzhe Guocheng (Obstruction by the Villains or Technical Obstacles - The Tortuous Process of Restoring the Tonghui Canal in the Ming dynasty), 奸豪阻挠抑或技术障碍: 明代修复通惠河的曲折过程", *Ming Dynasty National and Social Research Series*, No.11, 2013, p. 27.

[21] Hou Renzhi. "Beijing Dushi Fazhan Guochengzhong De Shuiyuan Wenti (The Issue of Water Resources in Urban Development in Beijing), 北京都市发展过程中的水源问题", *Peking University Journal*, 1955, p. 156.

[22] Ma Wensheng's memorial states: "Since the Chenghua reign (1465–1487), extravagant customs have prevailed in the capital. Both officials and ordinary citizens have competed to construct luxurious houses, thereby driving up the demand and price of timber. Consequently, opportunists from Datong [大同镇, a town in Shanxi province near Beijing] and Xuanfu [宣府镇, a town in Zhangjiakou (张家口), near Beijing], including members of ruling families, became heavily involved in the timber trade. They frequently mobilised local soldiers and civilians to form parties that entered the mountains, indiscriminately felling trees designated for protection. Regional commanders and subordinate officials, motivated by personal profit or superstitious beliefs, built unauthorised temples, constructed private dwellings, repaired non-essential government offices, or dispatched timber to powerful relatives. Military personnel were routinely conscripted for private labour, compelled to climb steep slopes to harvest timber, and forced to transport it by animal or human effort under extremely harsh conditions. Although public concern was widespread, no one dared to speak out. The original purpose of this timber usage and the actual quantities consumed remain uncertain; nonetheless, the volume sent annually to the capital greatly exceeded one hundred loads. A mature tree requires decades to reach full growth, yet these were already being harvested for both government and private purposes. If this continues, with six or seven out of every ten trees cut down, the mountains and forests will be completely exhausted within a few decades." [Original Chinese: 自成化年来, 在京风俗奢侈, 官民之家, 争起第宅, 木植贵, 所以大同, 宣府规利之徒, 官员之家, 专贩筏木, 往往雇彼处军民, 纠众入山, 将应禁树木, 任意砍伐. 中守, 分守等官, 或徽福而起盖淫祠, 或胎后而修造私宅, 或修盖不急衙门, 或送亲戚势要, 动私役官军, 入山砍木, 牛拖人拽, 艰苦万状, 怨盈途, 莫敢控诉. 其本虑取用者, 不知其几何; 贩运来京者, 一年之间, 岂止百十余? 且大木一株, 必数十年方可长成, 今以数十年生成之木, 供官私砍伐之用, 即今伐之, 十去其六七, 再待数十年, 山林必为之一空矣." Ma Wensheng, *Duansu Zuoyi - Jinfa Bian Shanlin Yizi Baozhang Shi (Duansu's Memorials - Prohibiting the Felling of Border Forests to Ensure Security), 端肃奏议-禁伐边山林以资保障事*, Vol.7, 1780, p. 305.

[23] A *zhang* (丈) is a traditional Chinese unit of length, equivalent to approximately 3.33 metres.

[24] Yu Minzhong, Qinding Rixia Jiuwen Kao (Imperially Commissioned Examination of Old Reports on the Capital, 钦定日下旧闻考, Vol.53, Beijing: Beijing Guji Press. Reprint, 1983, p. 851.

[25] *Ming Xiaozong Shilu (Veritable Records of Emperor Xiaozong of Ming), 明孝宗实录*, Vol.177, Guangzhou: Institute of History and Philology Academia Sinica. Reprint, 1962, p. 3262.

[26] The term "Supervising Secretary" is a translation adopted from Charles O. Hucker's interpretation in his book. Please see: Hucker, C. O, *Dictionary of Official Titles in Imperial China*. California: Stanford University Press, 1985, p.183.

[27] The Ming Xiaozong Shilu records: "To rehabilitate the roadway from east of Datong Bridge to west of Zhangjiawan [张家湾, a place name located in Tongzhou, 通州] to facilitate grain transportation, and to replace the gatekeepers at Qingfeng [庆丰闸, a sluice next to the Tonghui Canal in the Chaoyang district] and other sluices with road workers responsible for repairs.". [Original Chinese: 修大通桥以东, 张家湾以西一带道路以便粮运, 并改庆丰等闸闸夫为路夫, 专备修理.] Ming Xiaozong Shilu (Veritable Records of Emperor Xiaozong of Ming), 明孝宗实录, Vol.177, Taipeh: Institute of History and Philology, Academia Sinica. Reprint, 1962, p. 3262.

[28] Hu Kecheng. "Miaotang Yu Hegong: Jiajing Qinian Yunhe Zhi Yi Tanwei (Temples and River Workers: An Exploration of the Canal Discussion in the Seventh Year of Jiajing), 庙堂与河工: 嘉靖七年运河之议探微", *Canal Studies,* Vol.2, 2018, p. 86.

[29] Hu Jixun. "Tonghuihe De Xiujun Ji Zhengyi: Jianlun Mingdai Chaoting Juece Zhong De Liyi Quanheng (The Dredging and Controversy of the Tonghui Canal: Also, on Interest Trade-offs in Decision-Making by the Ming Dynasty Court), 通惠河的修浚及争议: 兼论明代朝廷决策中的利益权衡", *Ancient Civilizations*, Vol.9, No.2, 2015, p. 77.

[30] *Ming Xizong Shilu (Veritable Records of Emperor Xizong of Ming), 明熹宗实录*, Vol.7, Taipeh: Institute of History and Philology, Academia Sinica. Reprint, 1962, p. 335.

[31] Gao Shouxian. "Jianhao Zunao Yihuo Jishu Zhang'ai: Mingdai Xiufu Tonghuihe De Quzhe Guocheng (Obstruction by the Villains or Technical Obstacles - The Tortuous Process of Restoring the Tonghui Canal in the Ming dynasty), 奸豪阻挠抑或技术障碍: 明代修复通惠河的曲折过程", *Ming Dynasty National and Social Research Series*, No.11, 2013, p. 24.

[32] *Ming Xizong Shilu (Veritable Records of Emperor Xizong of Ming), 明熹宗实录*, Vol.7, Taipeh: Institute of History and Philology, Academia Sinica. Reprint, 1962, p. 335.

[33] Ibid., p. 335.

[34] Ibid., p. 335.

[35] Hu Kecheng. "Miaotang Yu Hegong: Jiajing Qinian Yunhe Zhi Yi Tanwei (Temples and River Workers: An Exploration of the Canal Discussion in the Seventh Year of Jiajing, 庙堂与河工: 嘉靖七年运河之议探微*", Canal Studies,* Vol.2, 2018, p. 79.

[36] An ancient Chinese measurement unit, with one *dan* equaling 50 kilogrammes.

[37] Han Guanghui, Beijing Lishi Renkou Dili (Historical Population Geography of Beijing), 北京历史人口地理, Bejing: Peking University Press, 1996, p. 84.

[38] Cao Shuji, Zhongguo Renkou Shi (A History of China's Population), 中国人口史, Shanghai: Fudan University Press, 2000, p. 287.

[39] Han Guanghui, Beijing Lishi Renkou Dili (Historical Population Geography of Beijing), 北京历史人口地理, Bejing: Peking University Press, 1996, p. 326.

[40] *Ming Shizong Shilu (Veritable Records of Shizong of Ming), 明世宗实录,* Vol.96, Taipeh: Institute of History and Philology, Academia Sinica. Reprint, 1962, p. 2248.

[41] A unit of length in China, where 1 *li* is equal to 0.5 kilometres.

[42] Yuan Huang's memorial states: *"*People in the southern regions transport grain from the Suzhou–Songjiang [苏州和松江] area to Zhangjiawan, covering a distance of more than 3,700 li. Yet the distance from Zhangjiawan to Beijing is only about 60 li. Remarkably, the expense for this short overland journey is nearly equivalent to the cost of the long-distance voyage by boat. In other words, the cost of transporting grain for 60 li by land is almost the same as that for 3,700 li by water. Consequently, once the Tonghui Canal is reopened for transportation, the savings will be immeasurable." [Original Chinese: 按三吴民运白粮自苏松至张家湾, 凡三千七百余里, 自湾抵京仅六十里, 而水运之舟价与陆运之车价略相当, 是六十里之费抵三千七百里之费也. 此河一开, 所省无算矣.]Yuan Huang, *Huang Du Shuili - Si Ku Quan Shu Cunmu Congshu (Huangdu Shuili- Series of Books Not Included in the Siku Quanshu), 皇都水利 - 四库全书存目丛书*, Vol. 222, 1605, p. 696.

[43] *Ming Shizong Shilu (Veritable Records of Shizong of Ming), 明世宗实录,* Vol. 96, Taipeh: Institute of History and Philology, Academia Sinica. Reprint, 1962, p. 2248.

[44] *Ming Shizong Shilu'*s text: The grain that had arrived totaled 1,993,800 dan, saving 113,300 taels of silver in transportation costs. [The original Chinese writing is: 粮运既至者, 一百九十九万三千八百有奇, 省脚价十一万三千三百余两.] Ibid., p. 2248.

[45] A tael (两, *liang*) was a monetary and weight unit in ancient China, approximately equivalent to 30 grams.

[46] Hu Mangquan. "Tan Wuzhong Chongxiu Tonghuihe Dui Tongzhou Fanrong Fazhan De Lishi Yiyi (On the Historical Significance of Wu Zhong's Reconstruction of the Tonghui Canal to the Prosperity of Tongzhou), 谈吴仲重修通惠河对通州繁荣发展的历史意义", *Beijing Water Affairs*, No.6, 2008, p. 58.

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