

justice, especially for the local population. The study has argued that sustainable and equitable approaches to resource management are needed to promote sustainable development and combat global environmental challenges. The findings of this research can inform policymakers about the importance of incorporating environmental and social justice considerations in policymaking, especially with regard to natural resource management. Overall, this study adds valuable insights to the field of international studies by highlighting how the exploitation of natural resources can have far-reaching effects, both locally and globally, thereby emphasising the need for interdisciplinary and inclusive approaches to addressing resource management issues.

Keywords: British Malaya, colonial, hydrology, international relation, Perlis.

INTRODUCTION

‘If you can control water, you can control everything’ (Abdullah, 2020). This statement depicts how the British attempted to control the water sources in Malaya before they managed to develop a modern water supply system throughout Malaya, and eventually amassed their wealth through unlimited control of economic outputs in Malaya. When the British gained control of Malaya, it was apparent that they were coveting control of the water sources due to the importance of these sources for the regional water system. Thus, it is imperative to understand the nature of the regional water system as it elucidates the rationale of the British to build a dam, which can be regarded as an astute and rational imperialism strategy (Tvedt, 2011). Furthermore, the reliance of the people of Malaya on rivers for their water supply led to the conclusion that the effective management of water sources played a significant role in shaping the growth and development of their traditional economy (Nasir, 2005: Moo & Fernando, 2018: Hasrah, 2022). For instance, Perlis, the smallest state in Malaya, faced conflicts related to the issue of water supply (Abdullah & Zakarya, 2022: Jamri, 2022). As a paddy-producing state, the issues of a lack of irrigation drainage and satisfactory water supply provision to the population were among the major problems in Perlis (Tang, 2002: Adam, 2015). This situation was exploited by the British as it seemed to indicate that Perlis was vulnerable to colonisation. With their in-

depth experience and knowledge in controlling water sources, the British demonstrated an aptitude for understanding the geographical condition of the state. The emphasis in terms of water imperialism in Malaya represents a new shift in the discourse on imperialism in Malaya. The British were knowledgeable about the hydrological system in Perlis and this development was driven by their economic interests, which were fundamentally influenced by the ability to structure the system of water supply.

The case of colonial hydrology in Malaya, particularly in Perlis, is a significant part of the larger discourse on imperialism, colonialism, and the management of natural resources in the international arena. Colonialism involves the exploitation and control of natural resources in colonised territories, and water resources are no exception (Curley, 2021). Meanwhile, colonial hydrology refers to the study of water resources and management strategies implemented during the colonial era in many parts of the world. Colonial powers developed water infrastructure mainly to satisfy their own needs, often without considering the social and ecological implications of their interventions (Beattie & Morgan, 2017). The colonial-era water management practises in Perlis was largely driven by the British government's need to secure a stable water supply for its colonial administration, military, and commercial interests. The case of colonial hydrology in Perlis reflects the patterns of imperialism and colonialism around the world. It demonstrates how colonial governments use scientific knowledge and technology to control and exploit natural resources, often to the detriment of local communities and ecosystems. Colonial hydrology also exemplifies the broader impact of colonialism on the environment, including the loss of ecological diversity, depletion of natural resources, and disruption of local ecosystems (Broich, 2007). When it comes to water specifically, one significant similarity between Perlis and other British colonies was the use of water management strategies to support colonial exploitation. This has often caused significant social and environmental damage, as the use of water resources was frequently prioritised for colonial activities, commercial interests, and European settlements at the expense of indigenous communities (Rodda, 2006).

In India, for instance, the British implemented policies and infrastructure that diverted water from traditional agriculture to European-style farming, leading to frequent water shortages in

rural areas. These policies had long-term social and economic consequences, as traditional farming practices were disrupted, rural communities were marginalised, and food insecurity became a persistent problem (Mosse, 2006). Similarly, in Malaya, the colonial government developed numerous hydrological dams, canals, and other infrastructure to secure a reliable water supply for colonial activities like mining, rubber and oil palm plantation, and urban development. These policies often resulted in environmental degradation, as dams and other structures interfered with natural water flows, resulting in soil erosion, increased pollution, and loss of biodiversity (Abdullah, 2019; Wan Ibrahim, 2022). Another similarity was how colonialism shaped the ways in which water resources were valued and managed. Colonial-era water management practices often prioritised increasing water supply and controlling water flow to meet the demands of colonial activities, neglecting the social and ecological needs of local communities and the environment. These examples highlight the patterns of colonialism and the use of water management practices for the benefit of colonial powers, often at the expense of indigenous communities and ecological integrity (Law, 2012). Additionally, these cases demonstrate the long-term consequences of these policies for social and economic development, environmental degradation, and water scarcity that continue to affect these regions even until today.

The current study has presented arguments about water imperialism in Malaya by highlighting the British domination which began by controlling the Strait States, the Federated Malay States and eventually the Unfederated Malay States. Indeed, British domination in Malaya could be traced to their ability in controlling and manipulating water sources in Malaya for their economic gains. This is because the British believed that exerting control over the water supply in Malaya would serve as a means of alleviating their concerns about potential conflicts with other colonial powers competing for dominance in Malaya (Tahir et al., 2023). Their ability in controlling and developing the water supply in Malaya facilitated their movements throughout Malaya, allowing them to dominate the economy with ease, strengthen their influence in Malaya, and allay their fears of the aforementioned threats.

Contemporary water scarcity issues can be traced back to colonial-era practices of water management. One of the significant effects

of colonial hydrology is the exploitation of water resources for the benefit of the colonial powers. This exploitation leads to the depletion of groundwater and the degradation of rivers, lakes, and other water bodies (Shamsul Bahri, 2021). In many cases, water resources are not managed sustainably, leading to significant ecological and social problems (Abdullah & Mohd Noor, 2019). It is therefore, relevant to examine the legacy of colonial hydrology in addressing contemporary water scarcity issues. One approach is to look at the potential of indigenous water management systems that pre-date colonial hydrology. Indigenous water management systems often relied on local knowledge, and these systems were adapted to local environmental conditions, making them more sustainable.

The current study takes the view that creating a plan for regular water supply in Malaya was driven by various economic interests in Malaya, such as mining, agriculture and trade. This study has also argued that the lack of irrigation sources for the agricultural economy had created opportunities for the sector to be controlled and developed, and this situation demonstrated how paddy cultivation activities could have spread throughout Malaya. This highlights the effectiveness of upstream control as the best imperialism strategy in Malaya, demonstrating how the British were able to protect their strategic interests through water supply management.

LITERATURE REVIEW

According to Brahma Chellaney (2014), the domination of water sources formed the basis of power and influence in Asian countries among colonisers. For instance, colonisers in Asia competed to have control over the water resources in the colony. In addition, Rohan D'Souza (2006) explains how the British became influential in modernising the water supply in India by introducing water supply modules that improved traditional water supply methods.

To date, studies related to colonial hydrology around the world, especially in Asia, have amply showed how the availability of water affects civilisation and human life. Research by Biggs et al. (2012) explains the importance of water management in the Mekong Delta which has protected and shaped the security in Vietnam through the

aspects of food income, water supply, politics, social, and so on. In Myanmar, the Irrawaddy Delta is considered to have achieved some level of self-development beginning from 1850 until today, which shows how this delta has become a strategic water resource for the country. This delta has been developed and maintained to meet the demands of water supply resources for the use of the population and sustaining the economy in Myanmar, and this can be referenced through research by Hedley et al. (2010).

Writings on colonial hydrology pre- and post-independence in Malaysia are more focused on the issue of water supply agreements between Singapore and Malaysia. For instance, Abdullah (2013; 2014), Che Ismail et al. (2012), Padzil (1998; 2007), and Abdan and Hussin (2011) have concluded that the rapid growth of Singapore as a strait state, especially before its independence, has been due to its success in controlling and developing raw water resources in Johor before having them channelled to Singapore.

Besides that, studies related to water development in Malaysia have focused on water supply issues and policies. For example, Chan (2019) states that water supply management in Malaysia is in good condition as Malaysia ranked as one of the better countries in Southeast Asia and Asia in terms of water management. This indicates that Malaysia's water supply management is better than most Asian countries, except for Singapore. In addition, Lai et al. (2017) extended their research on the public perception of non-revenue water management (NRW). They revealed a limited level of public participation in NRW management in Malaysia, demonstrated by the lack of knowledge and awareness of NRW, over-dependence on water utility and government agencies in reducing the NRW rates, and failure to submit reports on instances of leaking pipes. On the other hand, Yen (2014) states that the reform of the water services industry in Malaysia has experienced good reforms through the role shown by the National Water Services Commission (SPAN). Other than that, Abdullah et al. (2020) conducted historical research of a micro nature by focusing on the development of domestic water supply in the state of Kedah from 1957 to 1992, in relation to the issues of water supply management in the state. Based on the previous studies listed, an in-depth study of water imperialism in Malaya has not been carried out by researchers. In fact, this research offers a new dimension to the discourse on the issue of water imperialism in Malaya.

RESEARCH METHODOLOGY

This research was a historical analysis and employed qualitative research methods. To achieve the objectives of the current study, several actions and processes were performed, namely critique, analysis, heuristics, and historiography. As the compilation of a specified list of sources was important for researchers to explore and examine the sources related to this research during the period 1909–1950, library research was used to collect primary and secondary sources. The researchers visited the National Archives of Malaysia, the National Library of Malaysia, and the libraries of public institutions of higher learning (IPTA) in Malaysia to collect the required data. The research also examined official documents such as newspapers in Malaya in the 1950s, especially colonial office documents (CO), Perlis secretary files, and journal books.

This research began with a heuristic process which involved collecting and scrutinising information from sources such as newspapers, official documents, and other relevant materials that may contain important information related to matters on water supply construction in Perlis. The next process was the source critique, where the information obtained was compared with other sources such as books, journals, and scholarly writing. This process, which eliminated inaccurate information related to the research topic, was essential in order to determine the truth and validity of the information obtained. Then, an analytical process that involved inferences based on primary and secondary sources was carried out. This process resulted in a synthesis of the sources examined and thus, piecing together the important findings of the study. The final process was examining the process of the writing of the history, the study of the historiography (Mohd Noor, 2006).

RESULTS AND DISCUSSION

Water Irrigation in Perlis

Mr Meadows Frost, the first British adviser in Perlis who arrived in the state in 1909, realised that the residents in this state were highly dependent on water sources obtained from Perlis River. This was the main river, and was the source of irrigation for the many canals needed

to ensure the survival of civilisation here. The King of Perlis and the nobles were aware that maximum water control for agriculture could ensure political, economic, and social stability in the state. The British also realised that the state's security and stability depended on their efficiency in empowering and developing water resources. As the main paddy-producing state among the northern states, Perlis could expand the state's paddy cultivation activities if the irrigation system could be extended, given that the irrigation system had long been languishing in a poor condition that warranted more efficient development. Though the increasing demand for water had convinced the British to prioritise water control in the state, the question that arose was how to increase paddy cultivation in Perlis. Inadequate water for paddy cultivation activities was a cause of concern for the British as these activities had long been established as having economic potential. The British understood the issue well, and this situation provided them with the opportunity to share their expertise in the colony. Perlis has many canals to irrigate the paddy fields which are near where the local population has been using water supply specified for domestic use (CO 273/162). Thus, the Public Works Department (PWD) has taken steps to improve and ensure that the water supply operations throughout Perlis continue uninterrupted.

This has enabled cost savings in the water supply production for two concurrent uses, which is the domestic and multi-purpose use. In 1911, the Perlis Government spent the amount of \$ 7,500 to build canals. In 1921, the PWD spent a total of \$ 1,797 on a study to extend the canal system in Perlis. As a result of this 1992 study, the PWD built a canal at Sanglang Road and a 3 km long canal that runs from Simpang Ampat to Arau with a total expenditure of \$ 12,000. Apart from the canals, rivers in Perlis were extended and expanded to increase the quantity of river water while at the same time making it easier for residents to use the water supply. Some rivers such as the Raja River was extended to 2.68 km, expanding the capacity of the canal which was built in 1913. The work of extending the river was fully carried out by the *Raiat Labor* (Cheah, 2002). From 1926 to 1927, a total of 90.12 km of rivers and canals were carried out. This clearly indicated that the agenda of building and extending rivers and canals was the focus of the PWD in Perlis (CO 716).

Despite the continued usage of untreated water sources by residents, the Perlis Government has maintained the quality of the water supply.

For instance, the PWD took efforts to clean all the canals and rivers in the state to ensure that the water quality from the sources was safe for the people to use. This action shows the Government of Perlis was concerned with the health of the population and not allowed the use of contaminated water supplies. Moreover, the PWD spent \$ 1,998 to clean 19 ½ rivers in 1921 (CO 716, Annual Report of The Adviser to The Perlis Government 1339). The river and canal clean-up work in Perlis continued in 1926 with a total of 61.16 km of rivers and canals cleaned. From 1926 to 1927, river purification activities continued with 17.70 km of rivers and canals cleaned. This activity involved an expenditure of \$ 4,986. The actions taken by the PWD resulted in the water quality of the rivers and canals in Perlis being considered better than in other states like Kedah. Kedah was reported to be suffering from poor water quality issues which had led to the death of 5,500 people because of a cholera outbreak (CO 716/1: Sahidan et al., 2023).

Perlis also receive relatively good rainfall throughout the year during the stated period. This allowed underground water sources such as wells to be always available as rainfall rates continued to increase. For example, in 1915, the rainfall in Kangar was 88.12 inches (CO 716). This situation made it possible for Perlis residents to obtain an adequate water supply during the period in question. The current water supply situation in Perlis is also in a good condition, although it still depends on the availability of natural water supply, including some of the population still dependent on wells as the main source of water supply. Some wells in Perlis have been used by locals for a long time, such as the well in Kangar, the well in Arau, the well in Bukit Ketri, the well in the Sungai Wei, and the well in Tebing Tinggi (A. P 56-1349). This shows that the people of Perlis enjoyed the basic development of the sources of water supply as implemented by the state government at the time.

Perlis Water Works

The issues surrounding domestic water supply have often raised the question of whether the British prioritised the continuity of water supply to the economic sector over society's interest. The current study discovered that the British prioritised supplying water for the benefit of the economy over ensuring adequate water supply for the consumption of the population. For the British, the people would benefit from a strengthened irrigation system for paddy cultivation.

Therefore, after gaining control over the irrigation system, the British felt it was important to develop a water supply system for the people of Perlis because most of the local population were employed in rice cultivation. For safety purposes, quality water supply should be provided for the consumption of the population. In fact, this action demonstrated that through water, the British easily gained control over the population and made them slaves to the rice crop economy (Archaimbault, 1957). Moreover, the British were aware that a good water supply system could prevent the spread of waterborne diseases such as cholera and dysentery that were prevalent in Malaya at that time (Maslan, 2021: Abdullah & Mohd Noor, 2018: Abdullah & Mohd Noor, 2019). However, it is worth considering whether the British intervention in Perlis could potentially lead to significant changes for the local community. Indeed, the answer to that question lies in the subsequent actions taken by the British for its water supply plans in the state.

The Perlis Government had water supply plans since 1917, but the plans had to be postponed due to serious financial problems. Nevertheless, Perlis did not face a shortage of water supply or suffer from water-related diseases which affected the health of the population (CO 716). Hence, the state government began implementing domestic water supply plans in Kangar and Arau starting in 1926. Despite its relatively late occurrence compared to the other states, this situation did not present a significant challenge for Perlis. Instead, this situation made Perlis more independent and experienced in managing its water supply compared to the other states.

Kangar and Arau were chosen as the earliest locations for the modern water supply plans though they were only 9.5 km apart. Kangar was chosen because it was the capital of Perlis and the centre of government for the state (Ismail, 1997). Many government worker housings were built in Kangar and Arau, hence it was a priority for the state government to look after the welfare of these groups by providing good basic amenities to them. In addition, both areas were the main rice fields in Perlis (Osborn, 1860: Hill, 2012). In order to maintain the health of the people who used their rice plantations to stay healthy, modern water supply plans were implemented. This water supply plan was inaugurated by Raja Syed Alwi in October 1926.

The water supply plan utilised raw water sources from the Sungai Arau, Sungai Perlis, Sungai Jerneh, and Sungai Batu Kapur in Perlis.

In addition, raw water resources were available through underground water sources and nearby caves. The PWD had even set up a water tank that could store 50,000 gallons of water (Mohd Noor & Abdullah, 2020). The implementation of this water supply plan was historic, as it was the first modern water supply plan in Perlis to be implemented for domestic use. However, this water supply plan was a basic water supply plan providing untreated water. This was because the British were looking into building a water supply model and to try to see how far the model could resolve outstanding issues in its water supply plan in the first place. For example, in the implementation of a two-water supply plan, the PWD encountered some problems when the 3-inch water supply pipeline to be imported from England was not received as planned. This set back forced the water supply plan to be postponed to 1927. Both plans were only completed in November 1927, which incurred costs totalling \$ 227,700. The water supply plan produced 95,000 gallons of water daily (CO 716). On the main roads of Kangar and Arau were fountains installed to facilitate the villagers' use of the water supply. The supply of water had provided comfort to 3,000 people in the target areas at that time (A. P 56-1349).

The water supply to residents made available on the main roads was provided free of charge. Even at this time, no water supply system was installed in residents' homes, except that for staff living in government quarters. This is because the state government at the time did not make the water supply plan a state revenue prospect. Instead, the focus was only on improving the quality and standard of water supply in Perlis. It was also due to the fact that the majority of the population was poor and earned a low income. This clearly shows that the state government to a great extent had the best interests of the people of Perlis, especially the government staff living in government-provided homes. This is because the water supply was installed at the home of government employees, demonstrating that this group was fortunate compared to other Perlis residents. However, the implementation of the water supply plan was met with weather constraints that had disrupted the distribution of water to the residents at that time. From 1928 until 1930, Perlis suffered a severe drought. There was a drastic decline in rainfall and this had disrupted the source of the raw water supply to the water supply plant. To solve the problem, the PWD took several noteworthy approaches such as the implementation of a water supply consolidation was divided into three stages (A. P 56-1349).

First Phase of Water Rationing in Perlis

The PWD implemented the first phase of water ration in Perlis from 1 January 1930 to 30 January 1930. This decision was prompted by the observation that the water treatment plant areas experienced only 0.79 inches of rainfall, indicating a severe drought situation in Perlis. Therefore, the PWD had to reschedule the water supply times in Arau and Kangar. For example, in Kangar, the first phase of the supply of water was made available only from 6.00 am to 11.00 am. After that, the supply of water was only scheduled to be accessible from 4.00 pm to 6.00 pm. In Arau, the water supply was opened from 7.00 am to 10.00 am. The supply of water was then extended from 4.00 pm to 6.00 pm. It is during this phase that the daily amount of water supplied was 85,900 gallons of water (A. P 56-1349).

Second Phase of Water Rationing in Perlis

Beginning on 20 January 1930, the water plants in Kangar and Arau produced only 55,800 gallons of water daily. This indicated that the plant had lost nearly 50 per cent of its water supply compared to that in previous years. The PWD had no alternative solution except to reschedule the water supply times in both areas. For example, in Kangar, the water supply was opened only from 6.00 am to 9.00 am. Then the water supply was resumed from 4.00 pm to 6.00 pm. Whereas in Arau, the water rationing time was shortened from 4.00 pm to 6.00 pm.

Moreover, the PWD worked on a daily basis to provide water supply to Arau labourers in the city from well-built wells. In addition to blocking footpaths, roadside water fountains were locked to prevent residents from getting any water supply, including the issue of theft using private trucks. It was at this point in time that the rainfall at the water treatment plant location was 1.70 inches and thereafter, there was no further record of rainfall in Perlis. Water plants were completely dependent on springs that supplied 19,600 gallons of water daily (A. P 56-1349).

Third Phase of Water Rationing in Perlis

From 2 February 1930 to 24 March 1930, the third phase of the water rationing regime was implemented due to the scarcity of raw water

sources and the lack of rainfall over a long period of time. The PWD rescheduled the water supply times in Kangar from 6.00 am to 7.30 am. The water supply was continued at 4.30 pm and terminated at 6.00 pm daily. Whereas in Arau, water was supplied only when it was needed. This forced residents to use water from the wells which were supplied to labourers and religious houses by the PWD. In addition, due to the depletion of the water supply by the end of February 1930, private trucks also brought water which was obtained from the Sungai Pelarit to Kangar.

From 14 March 1930 to 21 March 1930, Perlis recorded a rainfall of 2.69 inches. The increase in rainfall increased the supply of water, including the availability of raw water sources from the well, which had increased to 55,800 gallons per day. However, the rain stopped, causing the daily total supply of water to fall to only 9,000 gallons. This led to a limited supply of water in Kangar. The PWD then took the approach of extracting water from the Sungai Jernih and distributing it using trucks in Kangar to government houses and labour camps. (A. P 56-1349).

Fourth Phase of Water Rationing in Perlis

From 24 March 1930 to 30 April 1930, the fourth phase of the water supply rationing in Perlis was implemented. Kangar was still given priority in the distribution of water when water supply was made available from 6.00 am to 7.00 am and then continued from 5.00 pm to 6.00 pm. Beginning in April 1930, Perlis received better rainfall. In the water plant areas, 7.05 inches were recorded and the quantity of raw water supply from the well increased to provide a maximum supply of 564,000 gallons of water daily. The drought ended and starting from 1930, the water supply was back in operation 24 hours a day (A. P 56-1349).

The Perlis Water Strategy

The year 1933 demonstrated good performance in the previously implemented production of water supply. The state government had always recognised the need to enhance the water supply system in Perlis to improve the quality of life of the people and foster the development of Perlis. The Perlis government gained a lot of experience in its managing water supply and it was time for the water supply in Perlis

to improve. The Perlis government expanded the existing water supply system as the demand for good and quality water increased over time due to the economic and population growth in several areas of Perlis. Consequently, the British introduced a treated water supply system to distribute clean water to the people.

Moreover, under the British-Perlis Treaty of 1930, the British position in Perlis was strengthened as Raja Syed Alwi, the then King proceeded with a new agreement with the British after the end of the Perlis state debt payment to the Federated Malay States (FMS). The treaty also signified that Perlis would be under the protection of the British. From a social point of view, the population was confident that the British would bring modernisation and prosperity to their lives. This sentiment prompted the British to continue to modernise and reform Perlis, including its water supply (Abd Manaf & Ahmad, 2014).

During this period, the British envisaged that the water supply system in Perlis will be able to provide a good revenue to the state government and that this source of income could be used for the implementation of other development plans in Perlis. For example, the British provided water supply to residential homes and the fees were determined on a monthly basis, and this meant that the state no longer provided free water to the population. The British action to impose water supply service charges was anticipated due to the shift in the treated water supply system, which had incurred a high cost in the management of water treatment processes. To ensure the health of the population, it was essential that the water supply was treated to prevent the spread of unwanted diseases. Also, the population was seen as able to afford the service as many of them had permanent jobs as farmers and or businessmen.

The water supply control in Perlis was manipulated with ease by the British. The British realised that they needed to implement an effective supply management strategy as previous attempts could not promise a smooth water supply in Perlis. The British were concerned as to whether the available water supply facilities had fulfilled the demands of all parties in Perlis. They were also concerned about the potential threats to their survival, such as the potential of political unrest arising from water-related concerns. Therefore, on 13 November 1933, the Perlis Engineer's assistant submitted a proposal to improve the

water supply system to the High Commissioner for The Malay States (HCO) to allow the Perlis Government to implement a water supply plan to improve the water supply system in Perlis (CO 716). The High Commissioner's Office responded to this request on 22 November 1933. The Secretary to the High Commissioner's Office, Sd. WD Barron suggested the state's reserves be increased along with the Perlis state revenues for a year before implementing those plans under the PWD. According to a statement from the HCO, it wanted Perlis to have a strong financial guarantee before implementing a water supply plan in the state. The justification for this action was grounded in the fact that Perlis was confronted with limited state revenues and reserves which had impeded development in the state (CO 716).

However, the Perlis Government was ready to implement the proposed water supply plan. In response to the HCO, on 27 November 1933, the Perlis Government stated that they had a good state reserve of \$ 237,798. On top of that, Perlis also received a loan repayment of \$ 177, 500 on opium planting in the state. Overall, the total assets of Perlis amounted to \$ 415, 298, with a state revenue of \$ 478, 791 as of 1933 (A. P. 264/1352). This indicated that the value of Perlis state assets and revenue This indicates that Perlis indeed has a strong financial guarantee. This statement showed that the state fulfilled the criteria set by the HCO as stated previously. Subsequently, the Perlis Government continued to work on improving the water supply plan in Perlis, with its focus on Kangar and Arau. The water supply plans included:

- i. Increasing the supply of water supply to 125, 000 gallons for 8 hours daily for the benefit of residents in the targeted areas.
- ii. Obtaining raw water supply from river sources, wells, groundwater, and springs.
- iii. Constructing water supply processing plants in Repoh, Genting Kabu, and Abi.
- iv. Implementating a water supply pumping system.
- v. Upgrading the plumbing system next to the drainage tank.
- vi. Implementating a sand water filtration process in stages at Abi Water Plant.
- vii. Water supply filtering at water supply locations.
- viii. Installating water meters at residential homes.
- ix. Installing water supply pipes and fountains in the target areas (A. E. 26/52).

The total cost of this water supply plan was \$ 20,000, evident by a tender offer for water pumping and filtration plant installation by the PWD (A. E. 26/52). The PWD had assigned Messrs. Huttenbach, Lazarus, and Sons Ltd for the purpose stated (A. E. 26/52). Messrs Huttenbach, Lazarus, and Sons Ltd and the Government of Perlis signed a contract agreement No. 12/63 of 1934 on 19 December 1934 and then began implementing the water supply plans to improve water supply performance in Perlis (S. S. Ps. 701-48). The PWD stated that the water supply plan was fully completed in 1935 (H. C. O. 742/36).

The PWD sent three samples of water taken from the Repoh Water Plant on 2 December 1935 to the Department of Pathology in Penang. The pathology department found that the water supply from the plant contained very high chlorine levels and was safe to drink. However, the water supply also contained the presence of B. Coli which was the cause of an outbreak of diseases such as cholera (A. E. 264/52: Affandi, 2020). However, according to the 1936 Annual Report for Perlis, the quality of the water supply in Perlis had been remarkably satisfactory (CO 716).

The water supply plan highlighted how water supply technology was practised in water plants located in Kangar and Arau. The water supply technology was an important part of the water supply treatment process. The water supply technology was not limited to the use of technology in the production of the water supply, but also included the way water distribution was implemented in the state. This indicates that the definition of water supply technology is broader than the common understanding held by all the parties concerned. For water supply treatment processes, raw water sources were treated before they can be used as they contained a variety of suspended solids and are carriers of colourless diseases, odours, and flavours. The process of water treatment was carried out at a location near the source of the raw water. Water plants were constructed in the area of raw water sources to facilitate the extraction of raw water and its subsequent processing. The level of treatment implemented depended on the state of the raw water source and the quality required for domestic and economic use (Nik Abllah, 1990).

Figure 1

Water Supply Treatment Process in Perlis

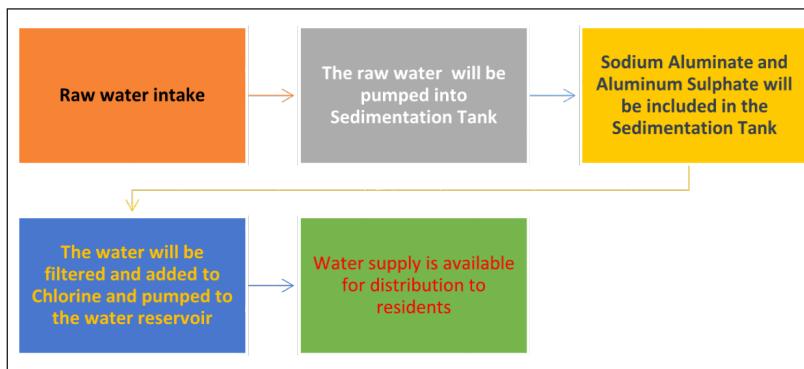


Figure 1 shows the process of water treatment in Perlis. The treatment of raw water sources had set a standard and guaranteed the quality of water provided to the people throughout Perlis. The condition of the crude water source obtained from the pump at the Sungai Jerneh to the sedimentation tank was slightly muddy and smelly. The process of treating the impurities was done by adding sodium aluminate and aluminium sulphate in the sediment tank. When the process was complete, the water was filtered and then chlorine was added. This treated water was then pumped to the pool before it was distributed to the population of Perlis. The supply of water was guaranteed in terms of the water's quality and cleanliness. There was also an installation of a 6-inch, 2.41 km water supply pipeline from the Repoh Water Plant to Kangar (A. E. 26/52).

Other areas in Perlis, such as Padang Besar and Kuala Perlis, had also implemented small-scale water supply schemes. By 1935, Padang Besar had a raw water source derived from an unnamed water reservoir, the water was then distributed to the villagers via a roadside fountain. However, this water supply plan was opposed by Dr Lowe, who was the then Railways Health Officer. He argued that the quality of the water supply in Padang Besar was extremely harmful, and thus residents there needed to boil their water before drinking it (H.C.O 1161/1935). Even though the water reservoirs were close to the village, the water were exposed to water pollution and other unhealthy human activities (S. C 3092-1355). This state of affairs indicated that the water supplied in Padang Besar at that time did not undergo any treatment.

In Kuala Perlis, which was the earliest location of British occupation in Perlis, the PWD implemented a small-scale water supply plan in 1935 by facilitating the setting up of a modern water supply system. The water supply plan was also implemented to ease the burden on the Kangar water plant that had previously supplied water to Kuala Perlis since its inception. This water supply plan utilised the raw water supply from the Sungai Wei, which was located 4.83 km from the Sungai Perlis. In total, this water supply plan cost \$ 1,500. In 1937, this water supply plan was implemented, with raw water from the source being channelled to a well built on the banks of the Sungai Perlis. Water was then distributed through a water fountain in the wells, indicating that the water supply provided to residents was not treated water supply (CO 716). At this time, the Perlis Government had imposed a water supply service charge on the population through a resolution agreed on 31 January 1937. The state government had set forth some necessary provisions which had to be observed by the residents of the state, as follows:

- i. If the rent of the house was \$ 360 within a year or not exceeding the amount specified, the total water supply charge would be \$ 12.00.
- ii. If the rent of the house was between \$ 360 to \$ 840 a year, the total water supply charge would be \$ 18.00.
- iii. If the rent of a house was \$ 840 or more within a year, the total water supply charge would be \$ 24.00.
- iv. Additional water fountains at residences were charged \$ 6.00 (A. P. No. 45-1350).

This decision by the state government was a reflection of the state government's concern about the welfare of the people of Perlis at that time. The payment of water supply service charges was based on the people's income and was designed to provide some financial relief and alleviate the burden of low-income residents. This clearly showed that all the people of the state had the opportunity to access the modern water supply built by the state government. This move was able to close the social gap in Perlis and proved that water supply development in Perlis is also a social development strategy in Perlis at that time.

The Decline of the Perlis Water Supply System

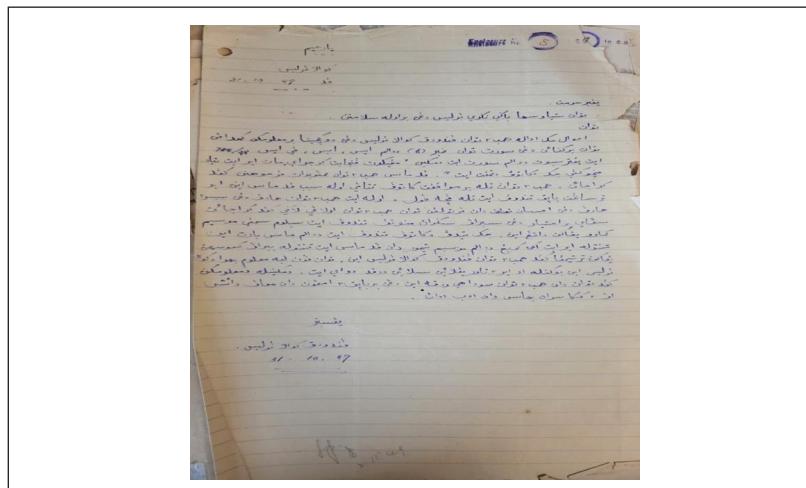
The defeat of the British by the Japanese in the Second World War was accompanied by the collapse of the facilities and amenities that the former colonialist had built in Malaya (Kratoska, 1997). For example,

water supply operations did not seem to be going well (Abdullah, 2019). The question that was raised was whether the problems that occurred in the water supply facilities at that time were a manifestation of the weaknesses of the British in the colony.

The British imperialism strategy, which was regarded as being able to bring progress to the people's lives, had to be rejected based on the situation in Perlis at that time. During British colonial rule, Perlis was plagued with the problems of water supply and this was a major concern to the state government. This situation clearly showed that the water supply module developed earlier had encountered problems and thus, created a serious situation for the state government and the residents of Perlis. This also relates closely to the quality of the water supply produced by existing water plants in Perlis. This was because only Abi's water plants had sand filtration while other water plants such as Genting Kabu and Kaki Bukit operated by providing untreated water supply to residents. In addition, in Kuala Perlis, the problem of poor water supply had become a serious issue. This was highlighted when a visit by the penghulu and state secretaries found that water tanks and drainage pipes there needed immediate repair. In addition, some residents had sent letters to the state secretary to ask the state government to improve the water supply in Kuala Perlis (R. C. Ps. 964-1946).

Figure 2

The Letter by the Residents of Kuala Perlis to the Perlis State Secretary on Water Supply Problems in Kuala Perlis in 1949



Recognising the shortage of water supply in Perlis, the state government worked to improve the existing water supply plan by proposing a 10-year agenda of development projects which was expected to start in 1950. The Perlis Government expanded efforts in other areas such as the rice fields in the southern part of Kangar which needed a water supply system. This was because the residents here had been, for a long time depending only on the supply of water from wells. Also, the state government with the help of the PWD felt the need for improvements to the water plants in Abi, Genting Kabu, and Kaki Bukit (S. S. Ps. 744-48). As a result, water supply processing paraphernalia such as sedimentation tanks and chemicals needed for water treatment valued at \$ 90,000, were placed at the Kaki Bukit Water Plant. At the Genting Kabu and Abi water plants, the PWD allocated \$ 70,000 to procure water supply processing machinery (S. S. Ps 29-48). For the southern part of Kangar, the source of raw water was taken from the river near Repoh which could supply up to 920, 000 gallons of water during dry seasons. Some water supply machinery such as pumps, filtration plants, and main tanks were required in order to provide a good water supply to 28,000 residents at the specified location. The total estimated cost for this water supply plan was \$ 1,250,000 (R. C. Ps. 964-1946).

The Raja of Perlis consented to the implementation of the stated water supply plan. The Perlis Government applied for a loan to the Federation of Malay States for this purpose through the Loan Ordinance 1949. However, after reviews were made, the Perlis Government failed to obtain the loan. This shows that the planned water supply plan was inefficient and that the water supply in Perlis was in dire straits and had threatened the health of the people. The failure in the implementation of the water supply plan underscored the state government's failure to take care of the welfare and health of the farmers involved in paddy cultivation in southern Kangar. In the 1950s, this situation resulted in an unsafe water supply, but the state government took action by requiring residents to boil their water (R. C. Ps. 964-1946).

Lessons from Colonial Hydrology in Malaya

Colonial hydrology in Malaya, especially in Perlis has provided several water resource management lessons that are relevant to contemporary water management practices in the country and around the world, especially those with colonial histories or are undergoing

rapid development. For example, they provide an example of how the imposition of foreign technologies and processes can leave a lasting impact on an ecosystem. This demonstrates the importance of acknowledging the wisdom of local knowledge and making use of indigenous approaches to water management in the design of modern water systems. Failure to heed this insight could lead to negative outcomes on the environment, and social and economic development (Ujang et al., 2022).

It also shows that water management systems should factor in the environment. For example, to expect what can happen when hydrological systems are disrupted by the construction of large infrastructure such as dams. In addition to the environmental impacts, poorly performing water systems can lead to decreased agricultural productivity, human displacement, and water scarcity (Andaya, 2018; Wan Ibrahim, 2022). Therefore, modern water management techniques should take into consideration the ecological interrelationships of water resources.

Besides that, water management in Malaya had only benefitted colonial commercial interests. Contemporary water management requires the inclusion of different stakeholders, such as indigenous communities, local private organisations, and governments; inclusive partnerships for water management can achieve significant environmental and social benefits. Finally, ongoing public participation in decision-making processes is crucial for the sustainable management of water resources. By involving communities in the decision-making process, water management goals that appreciate environmental and development needs can be developed. Lessons from the British water management history, when appropriately adapted to contemporary conditions, can serve as a valuable guide to achieve sustainable water management in the present day.

The case of colonial hydrology in Malaya provides a historical example of how water resources were manipulated by colonial powers to suppress local populations, promote economic growth, and maintain political power. This approach to resource exploitation and manipulation is not unique to British Malaya but can be seen across different regions of the world where resource exploitation and geopolitical power dynamics intersect (Mokhtar et al., 2021). For example, in the case of oil exploitation in the Middle East, Western

powers utilised their political and economic influence to control the production, transportation, and sale of oil resources for their own benefit, disregarding the ecological and social concerns of the indigenous peoples in the region (Mohd Noor, 2017: Mohd Noor & Ibrahim, 2023: Zakariah, 2017). Similarly, in Africa, imperialism by Western powers was driven in part by the desire to secure access to the natural resources that the continent had to offer, including water, oil, and minerals (Okumu, 2010: Gardner, 2012). In contemporary times, one can see the geopolitical struggles over resources playing out in the context of climate change, where developed countries, with their high carbon footprints, are often seen as responsible for the global crisis that negatively impacts the life chances of poor individuals globally (Banerjee, 2012: Vinodan & Kurian, 2015: Stoddard et al., 2021). The effects of climate change, such as floods, droughts, high temperatures, and natural disasters, are unevenly distributed across the world, disproportionately affecting low-income communities in less developed countries (Ishak et al., 2014: Narayan & Sealey-Huggins, 2017: Qingzhi, 2017: Abdullah et al., 2022). The lack of power in these countries to affect climate outcomes is seen as a form of neo-colonialism or environmental imperialism (Forsyth, 2014: Keefe, 2022). Therefore, the present case highlighted in this study resonates with other instances of resource exploitation and geopolitical struggles globally. It has clearly illustrated how the power dynamics between different actors affect access to resources and the control of resource utilisation (Zainuddin et al., 2023). The colonial hydrology in Malaya in this study which has focused on Perlis specifically, has underscored the importance of understanding the power dynamics that shape resource exploitation, as these dynamics directly impact the economic, social, and ecological development of nations and communities globally (Mat Enh, 2016: Hussain, 2022: Mohammed et al. 2022). Understanding power dynamics is necessary for the establishment of alternative environmental ethics that promote the equitable distribution of resources and address past and present injustices.

CONCLUSION

This study has argued that water control by the British was oriented towards its economic interests despite having to face certain challenges. The British had two strategic goals namely, to develop water irrigation sources for an agricultural economy and to establish stability.

In the early stages, the British managed to control the water supply in the state through certain strategies. However, their defeat to the Japanese led to the collapse of water supply operations, although their early achievements brought a huge change to the water supply system in Perlis. The British administration also failed to instruct the PWD to make changes as they were also in a weak position after the war. In fact, this situation demonstrates the incessant bad luck befalling the British in the colony. Their failure to maintain control over the water supply in the state had led to their fall, leaving Perlis with a major water supply problem.

The study of water in Malaya focussing on Perlis provides valuable insights into the state's nature of environmental and resource issues and the need for a more sustainable and just management of natural resources in the state. The study of colonial hydrology in Perlis exemplifies how political power and economic interests have historically shaped the management of water resources in the former colony, with severe environmental and social consequences. From an international studies perspective, such cases underscore the importance of understanding the complex and interrelated nature of environmental, social, and economic issues, and the need to develop more interdisciplinary approaches to managing global issues. Strategic collaboration and advocacy by policymakers, academics, civil society organisations, and other stakeholders are needed to promote sustainable, just, and equitable water management.

The current study offers practical implications for policymakers, such as on the importance of environmental justice, human security, and social equity considerations in shaping water resource management policies at the local, national, and international levels. This study highlights the need for more inclusive and participatory policymaking processes that engage local communities and various stakeholders in decision-making. In conclusion, the study of water in British Malaya reminds all parties of the critical importance of promoting sustainable, just, and equitable management of natural resources amidst global challenges such as climate change, population growth, and uneven resource distribution. It calls for ongoing discussions, collaboration, and action among policymakers, academics, and stakeholders to develop more effective and inclusive approaches to managing our planet's precious resources.

ACKNOWLEDGMENT

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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