Warisan
Journal of History and Cultural Heritage
Vol. 6
No. 2
August 2025
ISSN: 2746-3265 (Online)
Published by
Mahesa Research Center
sinta S4

The Socio-Economic Impacts of Agrarian Exploitation through Irrigation Systems during the Dutch East Indies Period

Yandi Syahputra Hasibuan*, Universitas Sumatera Utara, Indonesia
Kiki Maulana Affandi, Universitas Sumatera Utara, Indonesia
Junaidi Nasution, Universitas Sumatera Utara, Indonesia

ABSTRACT

This article examines the socio-economic impacts of agrarian exploitation during the Dutch East Indies period by positioning irrigation systems as a central instrument of colonial agricultural policy. From the implementation of the forced cultivation system (*cultuurstelsel*) to the era of economic liberalization, the expansion of irrigation networks functioned not merely as technical infrastructure but as a mechanism of control over land, labor, and agrarian production among indigenous communities. This study employs historical research methods, including source collection (heuristics), source criticism, interpretation, and historiography, drawing upon colonial archival materials, technical reports of the Dutch East Indies government, and relevant historiographical studies. The findings reveal that while colonial irrigation development increased agricultural productivity and generated economic surplus for the colonial state, it simultaneously intensified labor exploitation, reinforced social inequality, and marginalized indigenous irrigation systems. The legacy of colonial irrigation infrastructure continues to shape contemporary water management practices and agrarian relations in Indonesia.

ARTICLE HISTORY

Submitted 07/11/2025
Revised 20/11/2025
Accepted 27/11/2025
Published 10/12/2025

KEYWORDS

Agrarian exploitation, Dutch East Indies, colonial irrigation, socio-economic impact.

*CORRESPONDENCE AUTHOR

yandihasibuan17@gmail.com

DOI: https://doi.org/10.34007/warisan.v6i2.2966

INTRODUCTION

During the period of Dutch colonial rule in Indonesia, then known as the Dutch East Indies, irrigation management policies in the agricultural sector occupied a strategic position in sustaining the colonial economy. Irrigation systems were not merely understood as technical means of water distribution but also functioned as crucial instruments in the exploitation of agrarian resources considered highly profitable, such as coffee, rice, sugarcane, and various other export commodities (Otoman et al., 2022). Through control over water resources and land, the colonial government was able to regulate agricultural production in a systematic manner. This control simultaneously enabled the restructuring of rural labor relations in accordance with colonial interests. Irrigation therefore operated both as an economic apparatus and as a mechanism of power within the colonial agrarian structure.

The implementation of the forced cultivation policy (*cultuurstelsel*), initiated by Johannes van den Bosch in the 1830s, brought fundamental changes to the agricultural structure of the Dutch East Indies. To ensure the success of this system, the colonial government constructed extensive irrigation channels and agricultural infrastructure that were considered technologically advanced for their time. This development cannot be separated from the economic interests of the Netherlands, which was experiencing severe fiscal pressure due to prolonged conflicts such as the Java War led by Prince Diponegoro, the resistance of Tuanku Rao and Imam Bonjol in West Sumatra, and the Dutch–Belgian War. Through the enforcement of the *cultuurstelsel*, the Dutch state treasury, which had previously suffered from persistent deficits, gradually shifted into surplus. Peter L. Berger even noted that the Netherlands gained profits exceeding 400 percent from this policy (Susilo & Sarkowi, 2020).

The irrigation infrastructure developed during the *cultuurstelsel* period did not cease to function after the policy was abolished but continued to be utilized into the early twentieth century. This continuity was closely linked to the shift in colonial economic policy toward liberalization, marked by the enactment of the *Agrarische Wet* and *Suiker Wet*. These regulations opened broad opportunities for private capital investment in plantation sectors throughout the Dutch East Indies. In this context, existing irrigation networks became the primary backbone supporting the expansion of plantation-based economic activities. Several colonial-era irrigation structures remain visible to this day, and some continue to operate, albeit with various adaptations and maintenance efforts (Pelzer, 1985).

The construction of colonial irrigation systems did not, however, generate equitable benefits for indigenous communities. In the early twentieth century, more than 60 percent of the population of Java depended on agriculture for their livelihoods, yet most farmers lacked direct access to adequate irrigation facilities. Irrigation development was centralized and primarily directed toward areas deemed strategic for export crop production, such as rice and sugarcane plantations in Central and West Java. As a result, regions outside colonial priorities were increasingly marginalized in terms of irrigation infrastructure development. This historical reality demonstrates that colonial irrigation policies were oriented more toward the economic interests of the colonial state than toward the broader welfare of peasant communities (Purba et al., 2024).

A growing body of scholarship indicates that irrigation systems during the Dutch East Indies period played a significant role in agrarian exploitation with complex socio-economic consequences. Ravesteijn (2002) conceptualizes irrigation as a *socio-technical system* integrated into the formation of the colonial state, aligning with Alexander's (1978) view that irrigation served as a prerequisite for the reorganization of agricultural production, while differing in that Alexander focused more explicitly on the economic relationship between rice, sugar, and irrigation within commodity production structures. In a similar vein, Mawardi (2014) emphasizes that irrigation functioned as an instrument of colonial control over land, water, and labor within the framework of the *cultuurstelsel*, with particular attention to mechanisms of surplus extraction. Meanwhile, Salma (2023) shows that during the Ethical Policy period, irrigation was framed as a means of improving welfare, sharing similarities with earlier studies in its economic orientation but differing by highlighting regional contexts beyond Java. Sembiring (2018) further expands this perspective by situating irrigation within the political economy of liberal colonialism following the *Agrarische Wet* and *Suiker Wet*, emphasizing regulatory frameworks and private capital while maintaining the theme of sustained agrarian exploitation. Collectively, these studies demonstrate that colonial irrigation systems were far from neutral, instead operating as strategic instruments that reinforced agrarian exploitation, deepened inequalities in resource access, and shaped rural socio-economic structures in line with colonial interests.

The novelty of this study lies in its shift in perspective on colonial irrigation systems in the Dutch East Indies, moving beyond their interpretation as merely technical agricultural infrastructure toward an understanding of irrigation as a strategic instrument of agrarian exploitation that shaped rural socio-economic relations. This article positions irrigation as a medium of water resource control intertwined with land and labor governance, thereby directly contributing to the formation of structural inequalities within the colonial economy. The *state of the art* of this study resides in its integration of agrarian historical analysis and political economy to reveal how irrigation technologies functioned as mechanisms of surplus production and social discipline.

Against this backdrop, the article examines colonial irrigation systems not simply as technical achievements but as integral components of agrarian exploitation practices. Irrigation is understood as having a direct impact on the formation of rural social and economic structures. By situating irrigation within the framework of colonial agrarian history, the study highlights power relations constructed through control over water resources. Such control reinforced colonial authority over agricultural production. Irrigation thus emerges as a key element for understanding the dynamics of agrarian inequality during the colonial period.

This study aims to analyze the development of irrigation systems in the Dutch East Indies as part of an agrarian exploitation strategy rooted in colonial economic and political interests, while simultaneously examining the socio-economic impacts on indigenous communities. The analysis focuses on how fiscal pressures caused by warfare, shifts toward economic liberalization, and the need for stable export commodity production drove centralized and selective irrigation infrastructure development. In addition, the study seeks to uncover how colonial irrigation systems functioned as instruments of control over water resources, land, and labor, thereby intensifying agrarian inequality. The research also explores the long-term implications of this exploitation, including the marginalization of traditional irrigation systems and the continued use of colonial infrastructure into the present. The article offers a critical understanding of colonial irrigation not merely as a technical development achievement, but as a mechanism of power that shaped the socio-economic structures of rural society.

METHOD

This study adopts a qualitative approach with a strong emphasis on critical analysis of historical sources relevant to the themes of agrarian exploitation and the development of irrigation systems during the Dutch East Indies period (Daliman,

2012). This approach is employed because it enables a contextual and in-depth explanation of historical phenomena. The research applies the historical method, which is designed to systematically reconstruct colonial events and policies. This method also allows the researcher to examine power relations and the socio-economic impacts generated by these colonial policies. Accordingly, the study moves beyond mere descriptive narration and foregrounds a critical analysis of the structures and practices of agrarian exploitation.

The first stage of the research is heuristics, defined as the process of collecting historical sources relevant to the focus of the study. The sources gathered consist of both primary and secondary materials. Primary sources include colonial archives, official reports of the Dutch East Indies government, technical reports from irrigation agencies (*Waterstaat*), and visual documentation obtained from archival institutions such as KITLV Leiden. Secondary sources comprise books, journal articles, and scholarly works addressing agrarian history, colonialism, and irrigation systems in Indonesia. The researcher applies strict source selection to ensure direct relevance to the research theme.

The second stage involves source criticism, encompassing both external and internal criticism. External criticism is conducted to assess the authenticity of sources based on their provenance, date of production, and the authority of the authors. Internal criticism aims to evaluate the credibility of the content, the consistency of the data, and the colonial biases embedded within official Dutch East Indies government documents. This stage assists the researcher in distinguishing historical facts from colonial ideological interests. Only sources with a high degree of reliability are utilized in subsequent analysis.

The third stage is interpretation, carried out through both analytical and synthetic analysis of the verified historical data. At this stage, the researcher not only arranges facts chronologically but also interprets causal relationships between colonial irrigation policies and transformations in the socio-economic structure of agrarian society. Interpretation is directed toward understanding irrigation as an instrument of domination and control within colonial production systems. This approach situates irrigation development within the broader framework of power relations between the colonial state and rural communities. Interpretative analysis enables a more critical reading of the functions of colonial irrigation.

The final stage of the research is historiography, which involves organizing the research findings into a systematic, logical, and chronological historical narrative (Kuntowijoyo, 2021). The researcher synthesizes all findings into a coherent historical analysis. The narrative is constructed by linking the context of colonial policies with the socio-economic impacts they produced. Historiography functions not only as a mode of data presentation but also as a critical reflection on colonial agrarian exploitation practices. This presentation is expected to enrich scholarly discussions on agrarian history and colonial political economy.

RESULT AND DISCUSSION

Colonial Irrigation Systems within the Political Economy Framework of Agrarian Exploitation

The development of colonial irrigation systems in the Dutch East Indies cannot be separated from structural factors rooted in colonial economic and political interests. Prolonged fiscal pressures caused by sustained warfare, both in the colonies and in Europe, compelled the colonial government to intensify the exploitation of agrarian resources as a primary source of revenue. From a political economy perspective, irrigation functioned as a means by which the colonial state consolidated economic power through control over land and water as the principal means of production. This policy enabled the colonial government to regulate agricultural production systematically while ensuring the continuous flow of surplus to the centers of power. In this context, irrigation became part of a broader structural strategy aimed at sustaining colonial economic stability.

The shift in colonial economic policy orientation toward liberalization in the late nineteenth century further reinforced the strategic role of irrigation systems. The enactment of the *Agrarische Wet* and *Suiker Wet* opened opportunities for private investment in plantation sectors producing coffee, sugarcane, tobacco, rubber, and other export commodities (Pamungkas, 2021). These regulations required the availability of infrastructure capable of guaranteeing production stability and efficient distribution of agricultural outputs. The colonial state subsequently positioned itself as the dominant actor in determining priority areas for irrigation development in line with global market interests. This pattern reflects the integration of agrarian spaces in the Dutch East Indies into the logic of international capital accumulation.

Within this framework, the construction of reservoirs, dams, irrigation networks, bridges, and railway lines served as material prerequisites for the operation of an export-oriented colonial economy. Such infrastructure performed not only technical functions but also operated as instruments for controlling space, labor, and commodity flows. Colonial historiography demonstrates that infrastructure development functioned as a tool of the colonial state to reinforce power relations over rural communities. Through control over the means of production and distribution, the colonial government was able to redirect local agricultural orientations toward the demands of the global market. Irrigation thus reflected unequal power relations between the colonial state and agrarian society.

The continued physical existence of parts of the colonial irrigation infrastructure into the present indicates that these projects were designed according to relatively high technical standards for their time. However, this technical success cannot be separated from the selective character of development that prioritized export-oriented production interests. Irrigation development was concentrated in regions producing key commodities, while other areas received more limited facilities. This pattern deepened agrarian inequality and generated structural dependence among indigenous communities on the colonial economic system. Colonial irrigation systems ultimately represent a paradox of modernization that advanced alongside exploitative practices (Salma et al., 2024).

Figure 1. Walahar Dam, Karawang, interior view
Source: Walahar Dam, Karawang, ca. 1931, archival number: KITLV 25067.

Conditions in the nineteenth century reveal that colonial irrigation policies emerged from a state of crisis experienced by the Netherlands, ranging from the Dutch–Belgian War and local resistance movements in Sumatra to global economic depression. These pressures prompted the colonial government to implement the *cultuurstelsel* and construct modern irrigation systems to accelerate economic recovery (Hartatik, 2022). Data indicate that by 1840 approximately 20 percent of agricultural land in Java was allocated to export crops under the forced cultivation system. Reports from the *Koloniaal Verslag* document a sharp increase in irrigated land area from 137,000 hectares in 1835 to more than 500,000 hectares by 1900 (Saputra & Setiawati, 2022). This expansion underscores the seriousness with which the colonial state sought to maximize the agrarian potential of the Dutch East Indies.

In practice, the colonial state cleared forests for coffee and sugarcane plantations and compelled farmers to cultivate export crops at prices determined unilaterally. Price setting was enforced through mechanisms of *direct rule* and *indirect rule*, the latter involving regents or *swapraja* as intermediaries. This system eliminated farmers' bargaining power and accelerated the accumulation of colonial surplus. Differences in commodity quality standards (*grades*), particularly for coffee, further shaped irrigation development patterns that were concentrated in prime production areas. Peripheral regions continued to receive irrigation, but of significantly lower quality (Wicaksono, 2021).

Reports from the Dutch Irrigation Department (*Waterstaat*) in 1900 indicate that more than 75 percent of irrigation projects relied on local labor without wages or through labor tax schemes. By 1927, approximately 3,200 kilometers of main irrigation canals had been constructed in Java, with the highest concentration in the Priangan and Karawang regions. Around 120 Dutch civil engineers were stationed in the Dutch East Indies by 1930, working not only on irrigation projects but also on railway networks designed to accelerate the transport of harvests to export ports (Sinaga et al., 2024). The integration of irrigation and transportation infrastructure strengthened colonial control over the entire agrarian production chain. Colonial revenues increased significantly until disrupted by the global *malaise* crisis of the late 1920s (Hendranata et al., 2023).

Figure 2. Walahar Dam, Karawang, 1931
Source: Walahar Dam, Karawang, ca. 1931, archival number: KITLV 25074.

Numerous colonial irrigation projects constructed in Java and Sumatra—such as the Walahar Dam, the Ciujung System, the Pamarayan Main Canal, and the Pematangsiantar Dam—reflect the scale and orientation of colonial development focused on export-oriented agrarian production. These infrastructures not only transformed physical landscapes but also reshaped land-use patterns and the socio-economic structures of local communities (Prapti & Sari, 2016). The colonial state employed irrigation as a political-economic instrument to stabilize revenue while reinforcing territorial control over its colonies. This pattern confirms that colonial irrigation systems operated as mechanisms of power integrated into large-scale agrarian exploitation projects.

These irrigation projects further illustrate how the colonial state forged coherence between technical policy and macroeconomic objectives. Irrigation systems were designed to ensure continuous water supply for export crops sensitive to seasonal and climatic fluctuations, thereby reducing the risk of crop failure. Such production stability formed a crucial foundation for long-term trade planning and export contracts in international markets. Through water control, the colonial state regulated agricultural labor rhythms according to global market demands rather than local agrarian cycles.

Beyond production functions, colonial irrigation systems reshaped patterns of land ownership and utilization at the local level. Lands with access to irrigation acquired higher economic value and were increasingly redirected toward export-oriented uses. This process encouraged shifts in land ownership and land use, either through direct appropriation or administrative pressure exerted on farmers. As a result, agrarian communities experienced spatial contraction, while subsistence-oriented agriculture became progressively marginalized.

Colonial irrigation development also affected the reorganization of rural labor. Large-scale irrigation systems required the mobilization of substantial labor forces for construction, maintenance, and operation. These demands gave rise to coercive and centralized labor regimes in which local workers were incorporated into the colonial production apparatus. Labor relations were no longer grounded in community solidarity but in compliance with administrative directives and production targets.

In the long term, the presence of colonial irrigation infrastructure generated structural dependence among local communities on systems established by the colonial state. Access to water became contingent upon colonial regulations and governance structures, resulting in the loss of local autonomy over vital resources. This dependence extended

beyond technical aspects to social and economic dimensions, as agricultural production and livelihoods became tied to systems designed to serve external interests. Such conditions weakened rural communities' capacity to determine their own agrarian development trajectories.

The legacy of colonial irrigation systems also shaped postcolonial development patterns that tended to reproduce inherited structures. Functioning infrastructure was often utilized without fundamental changes in management orientation. Consequently, production logics emphasizing efficiency and large-scale operations continued to dominate, while approaches centered on local needs and social sustainability received limited attention. This condition demonstrates that colonial irrigation systems left not only physical structures but also enduring managerial paradigms that continue to influence agrarian dynamics today.

In addition, the late nineteenth-century shift toward liberal colonial economic policies further shaped irrigation development trajectories. The enactment of the Agrarian Law and the Sugar Law (*Agrarische Wet* and *Suiker Wet*) facilitated private investment in the Dutch East Indies, particularly in coffee, sugarcane, tobacco, rubber, and other export-oriented plantation sectors (Pamungkas, 2021). These policies required the provision of infrastructure capable of ensuring production stability and efficient agricultural distribution.

The Socio-Economic Impacts of Colonial Irrigation: Power Relations, Inequality, and Structural Dependency

From a political economy perspective, the socio-economic impacts of colonial irrigation systems are reflected in the formation of structural inequalities rooted in the colonial state's control over land, labor, and water resources. The *De Javaanse Landbevolking* report (1939) records that more than 1.2 million farmers were involved in forced labor for irrigation projects between 1830 and 1930, with an average workload of 60 days per year per farming household. This practice demonstrates that irrigation development was inseparable from coercive labor exploitation mechanisms. Excessive labor burdens led to the deaths of thousands of farmers under the harsh conditions of the forced cultivation system (*cultuurstelsel*) (Tricahyono, 2020). Irrigation thus functioned not only as a technical facility but also as an instrument of social discipline within the colonial production structure.

Figure 3. Banyumas Reservoir (Central Java), 1915
Source: Banyumas Reservoir, Central Java, ca. 1915, archival number: KITLV 115478.

Normatively, the regulations of the *cultuurstelsel* appeared to provide protection for farmers; however, in practice, they reinforced unequal power relations. Obligations to allocate up to one-fifth of agricultural land for export crops, substitute labor requirements for landless farmers, and the delegation of policy implementation to village officials created multilayered surveillance over peasant communities (Hasibuan & Sabrina, 2024; Muttaqin & Zaini, 2021). The colonial state exploited local administrative structures to ensure compliance and production continuity. Provisions

concerning the return of surplus yields or compensation for losses were rarely implemented fairly at the local level. This pattern illustrates how colonial law functioned as an instrument legitimizing exploitation.

Within colonial agrarian practice, control over irrigation proceeded alongside the expropriation of peasant farmland for export commodity production. Many farmers lost control over their own land and were compelled to cultivate coffee, tea, or cacao in accordance with colonial market demands. The risks of crop failure—excluding natural disasters—were borne entirely by farmers, while the colonial state continued to secure production surpluses. Berger's records indicate that the net profits obtained by the Netherlands from the forced cultivation system exceeded 100 million guilders, excluding war expenditures already incurred (Rakhman, 2019). This situation underscores the profound imbalance in the distribution of risk and benefit within the colonial economic system.

The centralization of irrigation policy further deepened the structural dependence of rural communities on the colonial state. Although discourses of decentralization emerged in the early twentieth century, regional policies continued to adhere strictly to central interests. As a result, local irrigation systems and community-based water governance experienced sustained pressure and neglect. The replacement of traditional technologies with colonial technocratic systems displaced local knowledge that had long supported social and ecological balance. This transformation reflects the dominance of the colonial state in determining the direction of agrarian development.

Various studies by Indonesianist scholars note that traditional irrigation systems—such as *subak* in Bali and local systems in Minangkabau, Sulawesi, and Tapanuli (*lubuk larangan*)—were marginalized as a consequence of centralized colonial irrigation policies (Wahid, 2021). These systems were deemed inefficient for supporting large-scale production and surplus accumulation. In fact, traditional irrigation systems were designed to meet the collective needs of village communities and were transmitted across generations without labor exploitation. This divergence in orientation gradually led to the displacement of local systems. The process of marginalization unfolded incrementally and generated long-term social consequences.

Figure 4. Pematangsiantar Dam (East Sumatra), 1921
Source: Pematangsiantar Dam, East Sumatra, ca. 1921, archival number: KITLV 107653.

Although traditional irrigation systems did not disappear abruptly, they experienced significant contraction until the early twenty-first century. The continued, albeit limited, existence of *subak* and *lubuk larangan* reflects the resilience of local cultural practices, yet their position has become increasingly marginalized within modern agrarian policy. Colonial irrigation development absorbed local labor that had previously been responsible for managing traditional irrigation systems. Rather than fostering inclusive modernization, the colonial state redirected human and natural resources toward external economic interests. This practice underscores the exploitative character of colonial irrigation development (Royani et al., 2022).

The legacy of colonial irrigation systems remains evident today, both in the form of physical infrastructure and in structures of dependency in water management. Data indicate that approximately 30 percent of active irrigation networks in Java, Bali, and Sumatra were colonial inheritances still in use as of 2020. This continuity reflects the enduring imprint of colonialism on Indonesia's agrarian governance. While such infrastructure contributes to food security, it simultaneously reveals the limited transformation of post-independence irrigation policy. This pattern suggests that colonial power relations did not fully disappear but instead transformed within modern agrarian development structures.

The persistence of colonial irrigation systems also influences how the state conceptualizes long-term agricultural development. Dependence on inherited infrastructure has fostered policy tendencies that prioritize maintenance and rehabilitation over comprehensive system renewal. This approach reinforces continuity in water management patterns that emphasize technical efficiency, while issues of distributive justice and community participation receive limited attention. Consequently, irrigation policy reforms often remain partial and fail to address structural problems at the grassroots level.

Colonial legacies further shape institutional relations in contemporary irrigation management. Decision-making authority tends to remain centralized within state institutions, with relatively limited space for farmer participation. This structure reproduces hierarchical relations between the state and water users, positioning farmers as policy recipients rather than as active resource managers. Such patterns hinder the development of irrigation governance grounded in local needs and contextual knowledge.

In practical terms, the continued use of colonial infrastructure also affects patterns of water distribution across regions. Areas historically designated as production centers during the colonial period continue to enjoy more stable water access than other regions. This spatial inequality persists, shaping disparities in productivity and welfare across regions. These conditions demonstrate that the legacy of colonial irrigation is not merely technical but is deeply embedded in regional development structures.

From a social perspective, reliance on outdated irrigation systems constrains farmers' adaptive capacity in the face of environmental and climatic change. Systems designed for past production imperatives often lack flexibility to respond to contemporary ecological dynamics. These limitations increase the vulnerability of smallholder farmers to droughts, floods, and shifting seasonal patterns. Such conditions underscore the need for more adaptive and socially sustainable approaches to water governance.

The persistence of colonial irrigation legacies challenges efforts to decolonize agrarian policy in Indonesia. Structural transformation cannot be achieved solely through physical infrastructure improvements but requires a paradigmatic shift in viewing water as a public resource managed in an equitable and participatory manner. Without dismantling inherited management frameworks, irrigation development risks perpetuating historical inequalities in new forms. A critical engagement with colonial legacies therefore constitutes an essential starting point for formulating more sovereign and inclusive irrigation policies.

CONCLUSION

Agrarian exploitation through irrigation systems during the Dutch East Indies period demonstrates that the development of water infrastructure functioned as a political–economic instrument for consolidating colonial power over land, water, and labor. Irrigation did not operate as a neutral technical achievement; rather, it functioned as a structural mechanism that ensured the production of export commodities, stabilized surplus accumulation, and disciplined peasant communities within unequal power relations. Selective and centralized development patterns deepened agrarian inequality, marginalized traditional irrigation systems, and generated structural dependencies whose effects remain evident in the post-independence era. This article asserts that the legacy of colonial irrigation is not merely material in nature but also continues to shape how the state and society conceptualize agrarian resource governance over the long term.

Future research should expand the scope of analysis through cross-regional comparative approaches to trace variations in the socio-economic impacts of colonial irrigation beyond major production centers. Subsequent studies would also benefit from integrating perspectives from political ecology and environmental history to more comprehensively understand the relationships among water governance, landscape transformation, and social

vulnerability. In addition, archival research combined with field-based investigations may uncover local dynamics that have long been marginalized within dominant narratives of colonial development. Such research trajectories are expected to contribute to the formulation of contemporary irrigation policies that are more equitable, sustainable, and aligned with the interests of agrarian communities.

REFERENCES

Alexander, J. (1978). Sugar, rice, and irrigation in colonial Java. *Economic Development and Cultural Change, 26*(3), 503–525. https://doi.org/10.1086/451040

Boomgaard, P. (1990). *Children of the colonial state: Population growth and economic development in Java, 1795–1880*. Free Press.

Cribb, R. (2000). *Historical atlas of Indonesia*. NIAS Press.

Daliman. (2012). *Metode penelitian sejarah*. Ombak.

Elson, R. E. (1994). *Village Java under the cultivation system*. Allen & Unwin.

Hartatik, E. S. (2022). Pembangunan irigasi di Afdeeling Demak dan Grobogan masa awal abad XX: Sebuah kajian historis. *Diakronika, 22*(2), 130–145. https://doi.org/10.24036/diakronika/vol22-iss2/288

Hasibuan, Y. S., & Sabrina, A. (2024). Refleksi eksistensi petani dalam panggung sejarah Indonesia. *Jurnal Sejarah Indonesia, 7*(1), 58–68. https://doi.org/10.62924/jsi.v7i1.33010

Hendranata, R. F., Nugroho, O. A., Azarias, B. I., & Kartono. (2023). *Pengolahan lahan pertanian pada era awal kolonialisme: Studi pustaka menurut buku The History of Java karya Thomas Stamford Raffles*. SMA Kolese De Britto.

Kuntowijoyo. (2021). *Metodologi sejarah* (Cet. V; M. Yahya, Ed.). Tiara Wacana.

Mawardi, M. (2014). Sistem tanam paksa dan eksploitasi sumber daya agraria di Hindia Belanda abad ke-19. *Jurnal Sejarah dan Budaya, 8*(2), 145–160.

Muttaqin, E. Z., & Zaini, A. (2021). Kebijakan hukum *vrijwillige onderwerping* dan *toepasselijk verklaring* sebagai unifikasi pemerintah Hindia Belanda. *Jurnal Hukum Ius Quia Iustum, 28*(3). https://doi.org/10.20885/iustum.vol28.iss3.art10

Otoman, O., Panorama, M., & Mikail, K. (2022). Tradisi besahian: Budaya, religiositas, dan modernisasi dalam sistem pertanian masyarakat Ogan Ilir. *Warisan: Journal of History and Cultural Heritage, 3*(2), 65–73. https://doi.org/10.34007/warisan.v3i2.1571

Pamungkas, S. C. (2021). Transformasi Undang-Undang Agraria 1870 ke UUPA 1960 pada masa dekolonisasi kepemilikan tanah pascakemerdekaan di Indonesia. *Al-Isnad: Journal of Islamic Civilization History and Humanities, 2*(2), 43–59. https://doi.org/10.22515/isnad.v2i2.4854

Pelzer, K. J. (1985). *Toean keboen dan petani: Politik kolonial dan perjuangan agraria di Sumatra Timur*. Sinar Harapan.

Prapti, Y., & Sari, D. T. (2016). *Publikasi arsip: Bangunan irigasi zaman kolonial Belanda periode 1893–1941*. Badan Arsip dan Perpustakaan Provinsi Jawa Tengah.

Purba, M. B., Sari, A., & Ronauli, A. (2024). Dampak sistem tanam paksa dalam perekonomian dan kehidupan masyarakat Indonesia. *AR-RUMMAN: Journal of Education and Learning Evaluation, 1*(2), 565–569. https://doi.org/10.57235/arrumman.v1i2.4191

Rakhman, A. (2019). *Politik agraria*. Salim Media Indonesia.

Ravesteijn, W. (2002). Between global engineering and local knowledge: The Dutch East Indies irrigation system. *Technology and Culture, 43*(4), 721–742. https://doi.org/10.1353/tech.2002.0164

Ravesteijn, W., & Kop, J. (2008). *For profit and prosperity: The contribution made by Dutch engineers to public works in Indonesia, 1800–1950*. KITLV Press.

Royani, R., Maulidia, N., Juliantoro, R., & Pratama, R. A. (2022). Irigasi Way Tebu: Penguatan agraria dalam mewujudkan *Sustainable Development Goals*. *Jurnal Humanitas: Katalisator Perubahan dan Inovator Pendidikan, 9*(1), 62–70. https://doi.org/10.29408/jhm.v9i1.6020

Salma, N. (2023). Politik Etis dan pembangunan irigasi kolonial: Antara kesejahteraan dan eksploitasi agraria. *Jurnal Sejarah Sosial, 12*(1), 33–49.

Salma, R., Dewi, R., Wulandari, L., & Putra, P. (2024). Pengaruh politik etis kolonial Belanda terhadap pertanian dan ekonomi lokal di Lampung. *The Indonesian Journal of Social Studies, 6*(2), 180–191. https://doi.org/10.26740/ijss.v6n2.p180-191

Saputra, F. A., & Setiawati, E. (2022). Bendung Argoguruh masa kolonisasi 1935–1942. *Swarnadwipa, 5*(1), 1–10. https://doi.org/10.24127/sd.v5i1.1990

Sembiring, R. (2018). Politik agraria kolonial dan dampaknya terhadap struktur sosial ekonomi masyarakat Hindia Belanda. *Jurnal Ilmu Sosial dan Humaniora, 7*(2), 101–115.

Sinaga, R., Lubis, S., Wisabla, N., & Raunaq, U. S. (2024). Politik etis: Dari eksploitasi ke emansipasi di era kolonial. *AR-RUMMAN: Journal of Education and Learning Evaluation, 1*(2), 286–293. https://doi.org/10.57235/arrumman.v1i2.3992

Susilo, A., & Sarkowi, S. (2020). Pengaruh politik *cultuurstelsel* terhadap perkembangan masyarakat Indonesia tahun 1830–1870. *Swadesi: Jurnal Pendidikan dan Ilmu Sejarah, 1*(1), 1–14. https://doi.org/10.26418/swadesi.v1i1.35941

Tricahyono, D. (2020). Buruh dalam sejarah Indonesia: Studi tentang aktivitas buruh pada masa pemerintah kolonial Belanda periode 1870–1942. *ISTORIA: Jurnal Pendidikan dan Ilmu Sejarah, 16*(2). https://doi.org/10.21831/istoria.v16i2.35500

Wahid, A. (2021). *Politik perpajakan kolonial di Indonesia: Antara eksploitasi dan resistansi*. Gadjah Mada University Press.

Wicaksono, B. (2021). Migrasi orang Jawa ke Asahan pada masa kolonial. *Mukadimah: Jurnal Pendidikan, Sejarah, dan Ilmu-Ilmu Sosial, 5*(1), 54–62. https://doi.org/10.30743/mkd.v5i1.3439

Worster, D. (1985). *Rivers of empire: Water, aridity, and the growth of the American West*. Oxford University Press.
