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Research Article

Long-Term Socio-Ecological Legacies of Colonial Irrigation in Lampung, Indonesia (1935–1993)

M. Nehza Rausan Shadra[1]*, Muhammad Akmansyah[2], & Nurnazli[2]

[1]Universitas Negeri Malang, Indonesia
[2]Universitas Islam Negeri Raden Intan Lampung, Indonesia

Abstract

This study evaluates the socio-ecological consequences of the Argoguruh Dam irrigation system from the Dutch colonial era (1935–1942) through the New Order period (1993). Using an environmental history approach informed by Richard Grove's Green Imperialism and path-dependency perspectives, the study examines the historical background of the project, its social and environmental impacts, and the long-term continuity of those impacts. A qualitative, library-based method was employed using colonial newspapers, government reports, and local newspapers such as *Berita Yudha* and *Harian Ekonomi Neraca*. The findings show that the Argoguruh Dam significantly increased rice production and accelerated the expansion of transmigrant settlements in Trimurjo–Metro. At the same time, the project contributed to large-scale deforestation, watershed sedimentation, and the marginalization of indigenous Lampungese communities. These socio-ecological transformations persisted into the New Order era through irrigation rehabilitation projects, transmigration expansion, and mega-agrarian development schemes.

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*Corresponding Author

mnehza.rausan.2407326@students.um.ac.id

INTRODUCTION

On August 4, 1935, the groundbreaking ceremony for the construction of the Way Sekampung Dam, now the Argoguruh Dam in Tegineneng, Pesawaran Regency, was held in an official ceremony attended by representatives of the Governor-General in the Lampung Residency (De Locomotief, 1935; Gouvernement van Nederlandsch-Indië, 1938). This irrigation system was designed by Ir. Wehlburg (Puspita et al., 2025), the first official irrigation engineer from Telokbetong (De Locomotief, 1935). This project was planned by the head of the Lampung Residency and a driving force behind the Javanese colonization program in the Sukadana–Trimurjo–Metro region, H. R. Rookmaaker, who also received attention from the governor-general (De Locomotief, 1935). The dam spans and impounds the flow of the Way Sekampung River, which flows eastward toward the Javanese transmigration settlement in the Sukadana Complex (*Soekadana Complex*), Trimurjo–Metro, the first administrative settlement in the area (De Indische Courant, 1938). The project was designed to support the expansion of irrigated agriculture in the growing transmigration settlements of Trimurjo–Metro (Puspita et al., 2025; Shadra & Subekti, 2025).

Constructed between 1935 and 1937, the Argoguruh Dam was inaugurated on September 21, 1938 (De Indische Courant, 1938). Before irrigation, Trimurjo's farmland depended largely on rain-fed rice cultivation with only one annual harvest. After the irrigation system became operational, harvest frequency increased to two or three cycles per year, accompanied by rising agricultural output and income (Puspita et al., 2025; Valentino, 2025). Nevertheless, both colonial and later narratives largely emphasized the project's technical success while overlooking its socio-ecological consequences (De Indische Courant, 1937; De Locomotief, 1935).

De Indische Courant (1937) not only presented visual indicators of prosperity but also documented the project's social and environmental costs. The grueling labor demands imposed on transmigrants, compounded by the threat of malaria. Other reports detailed the clearing of forests and swampy land for roads and irrigation canals, indicating early forms of ecological destruction. By the New Order era, Lampung was repeatedly framed as a strategic rice-production region under the Rice Self-Sufficiency program (Harian Ekonomi Neraca, 1993). Therefore, the project's 'success' must be

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understood critically as part of a developmental discourse that prioritized technical achievement while marginalizing its social and ecological consequences.

Previous studies on the Argoguruh Dam and the Sukadana–Trimurjo colonization project have largely emphasized the positive economic effects of irrigation development. Research by Puspita et al. (2025) and Valentino David (2025), for instance, highlights improvements in agricultural productivity and living standards among transmigrant communities following the construction of the dam. Similarly, Saputra and Setiawati (2022) discuss the commercialization of agricultural production and the emergence of middlemen domination in the rice trade, particularly involving Chinese merchants. However, these studies focus primarily on socio-economic transformation and pay limited attention to ecological consequences.

Other works approach the issue from broader colonial and agrarian perspectives. Salma et al. (2024) examine the Ethical Policy and colonial agricultural expansion in Lampung, providing context for the political motivations behind irrigation and transmigration programs, although without specifically discussing the Argoguruh Dam. Meanwhile, the author's previous study on the Trimurjo–Metro transmigration project (Shadra & Subekti, 2025) analyzed the historical development of Javanese migrant settlements but did not address the socio-ecological implications of irrigation development.

Overall, previous scholarship has tended to frame the Argoguruh project primarily as a technical and socio-economic success, while the long-term ecological transformation and postcolonial continuity of the irrigation system remain underexplored. This study addresses that gap by examining the socio-ecological consequences of the Way Sekampung irrigation system from the colonial era through the New Order period using an environmental history perspective informed by Green Imperialism.

This study is based on three main questions: 1) What historical background served as the motivation for the Argoguruh Dam Irrigation Project? 2) How has the Way Sekampung River Irrigation Project influenced the social life of the community and its environment in the Sukadana Complex area, particularly in Trimurjo–Metro? and 3) What are the ongoing socio-ecological impacts of this project from the era of Dutch colonialism through the New Order? This study argues that the construction of the Argoguruh Dam Irrigation Project produced significant and lasting socio-ecological impacts, which persisted through the New Order era and continue to shape Lampung's environmental and social conditions today. The novelty of this research is expected to re-examine the Argoguruh Dam project as a colonial irrigation project that, while successfully increasing agricultural productivity, also caused demographic and ecological impacts that have had long-term effects on the geography of Lampung, extending into the New Order's Rice Self-Sufficiency Plan.

METHOD

This study employs a qualitative, library-based historical approach (Davey & Benjaminsen, 2021; Hall & Liebenberg, 2024). Analytically, the study combines environmental history (Caggiano & Weber, 2023) with Richard Grove's concept of Green Imperialism (1995), which explains how colonialism reshaped tropical environments through resource extraction and environmental management. This framework is used to examine the continuity of colonial ecological engineering into the New Order's rice self-sufficiency (*Swasembada Beras*) policies.

The study draws on both primary and secondary sources. Primary colonial materials consist of Dutch newspapers and government reports obtained from *Delpher*, including *De Locomotief* (1935), *De Indische Courant* (1937, 1938), colonial travel accounts by H. C. Zentgraaff and W. A. van Goudoever (1936), and the official report *Programma van het verblijf van Zijne Excellentie den gouverneur-generaal van Nederlandsch-Indië* (1938). In total, twelve newspaper issues and three government reports from 1935–1938 were systematically reviewed. Primary postcolonial and local sources include *Berita Yudha* (1984), *Harian Ekonomi Neraca* (1993), Sjamsu's *From Colonization to Transmigration* (1960), and Hardjono's study on unassisted transmigration (1984), which were used to

trace the continuity of irrigation expansion, transmigration policy, and ecological change into the New Order era. Secondary sources consist of academic books and journal articles used as interpretive and comparative literature. To reduce colonial bias, colonial reports were cross-checked against local and postcolonial sources and read "against the grain" by examining contradictions, omissions, and incidental references that reveal socio-ecological impacts often obscured in official narratives.

Following Kuntowijoyo's historical method (2003), the research proceeded through four stages. First, heuristics involved searching for archival materials via *Delpher* and *MPN Kondigi* for primary sources, as well as secondary literature from Google Scholar. Second, source criticism assessed the authenticity, credibility, and consistency of the sources while comparing colonial materials with local and postcolonial evidence to minimize bias. To mitigate such bias, interpretations of Dutch sources were cross-checked against local literature, postcolonial studies, and non-colonial visual data. Colonial reports were read 'against the grain' by identifying contradictions between the official narrative and the report's own subtext. For instance, De *Indische Courant*'s coverage of the dam's progress was read not for its claims of 'success' but for its incidental mentions of grueling labor conditions, malaria threats, and wildlife displacement, details that undermine the official story of unproblematic development. Similarly, Zentgraaff's travel reports (1936), which celebrated colonial 'progress' and the 'conquest' of wilderness, were critically examined for their descriptions of large-scale forest clearing, elephant killings, and habitat disruption, revealing ecological violence embedded within colonial development narratives. Third, data was analyzed using source triangulation to capture local Lampungese farmers' colonial experiences. Fourth, historiography synthesized the findings into a comprehensive narrative of the Argoguruh project's social and environmental impacts on the Trimurjo–Metro area.

RESULT AND DISCUSSION

History of the Argoguruh Dam Irrigation Development Project

Lampung was selected as the site for the Javanese population resettlement project initiated in 1905 by the Dutch colonial government (Dahlan, 2014), with the first chosen location being Gedong Tataan, which fell under *the Telokbetong Subdistrict* under the leadership of Assistant-Resident Heytling (De Indische Courant, 1937; Gouvernement van Nederlandsch-Indië, 1938). This project was a result of the colonial government's solution to reduce the population of Java, which was simultaneously increasing (Fahira & Setiawati, 2022). This is evidenced in a Dutch newspaper article titled "*Causerie*," which explicitly explains the program's objective:

> "…illustrated by films of the latest works, through which those present could gain an idea of how people worked, and still work, to bring the colonization of Java to the desired goal, namely to relieve Java from its overpopulation." (Soerabaijasch Handelsblad, 1937)

This colonization program was part of the Ethical Policy, which utilized irrigation, transmigration, and education as instruments of colonial control to increase the productivity of the colony while simultaneously strengthening Dutch dominance (Salma et al., 2024). Sukadana–Trimurjo was one of the largest resettlement areas, with a population of approximately 26,250 in 1938 (Gouvernement van Nederlandsch-Indië, 1938), located in the fertile Way Sekampung River Basin. The colonial government organized land distribution by block, allocating each transmigrant family ¼ bouw of garden land (0.19 ha) and 1 bouw of paddy field or dry field (0.75 ha) (Nieuwe Apeldoornsche Courant, 1937; Puspita et al., 2025). Initially, the primary crops cultivated in this region were limited to upland rice (paddy fields) and secondary crops (taro, papaya, cabbage, carrots, corn, and cassava), which were highly dependent on rainfall and thus frequently resulted in crop failures (Saputra & Setiawati, 2022). The colonial government exploited these complaints from transmigrants to build dams and irrigation systems, which were expected to increase production while also generating tax revenue from agricultural surpluses (Maassen, 1937).

Structurally, this policy drove significant demographic change in Lampung. Sjamsu (1960) notes that the Javanese migrant population increased from 51,605 in 1935 to 173,959 in 1941, a 237

percent rise, thereby surpassing the indigenous Lampungese population (approximately 215,000). This demographic shift had long-term political implications. As Sjamsu (1960) later observed, the concentration of Javanese settlers in Lampung created a new agrarian constituency that continued to influence land-use policies even after independence. Although direct colonial evidence for a deliberate 'lock-in' strategy is lacking, the demographic outcome, namely Javanese numerical dominance, persisted and shaped postcolonial transmigration policies.

Despite its developmental promises, the project depended heavily on migrant labor contributions. Transmigrants were required to contribute labor to the project for several weeks each year (Puspita et al., 2025). Formally, colonial authorities framed this obligation as a communal contribution tied to land allocation and settlement support rather than as compulsory labor. In practice, however, migrants had little room to refuse participation, since access to land, food provisions, and settlement security depended heavily on compliance with the irrigation works. Although colonial regulations did not explicitly classify the system as "forced labor," the combination of mandatory participation, minimal compensation, and dependence on colonial land allocation created labor conditions that were effectively coercive or semi-coercive in practice. The article "*Het irrigatiewerk*" (De Indische Courant, 1937) notes that the compensation for labor consisted of salted fish and two *kati* (1,2 kg) of rice per cubic meter of excavation, with only one *kati* (600 grams) of rice and one-third of the salted fish given immediately, while the remainder was set aside for the family. Additionally, the contractor brought in laborers from Garut, who were considered hardworking ground workers (*werkkrachtige grondwerkers*), to construct the main canal. This account underscores that the Dutch relied more on Javanese labor than on the local Lampung population (Soerabaijasch Handelsblad, 1939).

The work was awarded by Department V. and W. (Public Works and Irrigation) to three Dutch contractors: Algemeen Indisch Aannemersbureau (A.I.A.), Sitsen, and Louzada, with a contract value of *ƒ*93,250 for an initial irrigation target of 25,000 bouw (De Locomotief, 1935). According to the *Programma* report (1938), the Argoguruh irrigation project consisted of three main structures: the *Argoguruh Water Intake*, 76 m long and 4.60 m high, made of granite, with construction costs of *ƒ*160,000; the *Hoofdkanaal*, 12 km long, to channel water to the Sukadana settlement center; and the *Hoofdverdeelwerk Trimoerdjo* with secondary and tertiary sluices, costing *ƒ*70,000.



Figure 1. The Argoguruh Dam (Watervang Argoegoeroeh) in 1938. This concrete-granite weir, 76 m long and 4.60 m high, was the main water intake for the Way Sekampung irrigation system. Its construction symbolized colonial technological control over nature, converting a free-flowing river into a managed resource for rice cultivation.
Source: Gouvernement van Nederlandsch-Indië, 1938

Figure 1 shows the Argoguruh Weir, a 76-meter-long water intake that diverted water from the Way Sekampung River into the main canal. Figure 2 depicts the Trimoerdjo distribution station, a sluice gate that regulated flow to secondary and tertiary networks. Together, these structures illustrate the

centralized hydraulic governance of colonial irrigation. By controlling water distribution, the colonial state regulated cropping patterns, land use, and agrarian production, turning irrigation into a tool of agrarian governance rather than a neutral technical intervention.



Figure 2. Main distribution station (*hoofdverdeelwerk*) at Trimoerdjo. This sluice gate regulated water flow from the main canal to secondary and tertiary networks. Functionally, it exemplifies the centralized, top-down control of water, mirroring the colonial state's hierarchical governance of both land and people.
Source: Gouvernement van Nederlandsch-Indië, 1938

The groundbreaking ceremony took place on Sunday, August 4, 1935, attended by the Head of the Lampung Residency, R. Rookmaaker; Chief Engineer Van Haeften from V. en W.; and agricultural official Mr. Bastiaens from the B.B. Department; and was welcomed by the project designer, Ir. Wehlburg (De Locomotief, 1935; Puspita et al., 2025). This project subsequently resulted in a 12-km-long main canal along with the Poenggoer (Punggur) and Batanghari secondary canals, estimated to span 75 km, while at kilometer 58 south of Metro, large-scale deforestation was underway; according to Zentgraaff's records (1936), herds of elephants were still crossing the road, though in the colonial narrative, these deforestation and poaching activities were framed as a 'conquest' for the welfare and security of the transmigrants.



Figure 3. Clearing the Batanghari Road during the Sukadana colonization, April 1938. The photograph shows a newly cut road still surrounded by primary forest. In colonial reports, such images were used to document 'progress' and 'conquest' of nature. However, read critically, they also reveal the scale of deforestation, wildlife habitat destruction, and the physical brutality of land clearance, key starting points of long-term ecological degradation.
Source: Gouvernement van Nederlandsch-Indië, 1938

According to *De Indische Courant* (1937), clearing the Batanghari route involved felling dense secondary forest on swampy, clay-rich soil. Workers had to build bridges over wetlands, and a six-

meter-wide road was eventually opened after weeks of labor. The same source notes that local officials shot nine elephants in a single day, and tiger hunting was common. Colonial reports framed these activities as necessary for settler safety and economic progress. However, from an ecological perspective, the massive clearance of primary and secondary forest, combined with systematic wildlife killing, marked the beginning of irreversible habitat loss. The framing of environmental transformation as 'conquest' legitimized an extractive reorganization of the landscape for colonial agricultural expansion. *De Indische Courant* highlights that dam construction required arduous labor to overcome dense jungles, sticky clay, and malaria threats (De Indische Courant, 1937). In this sense, ecological transformation was not merely a side effect of colonial development, but a structural precondition for the expansion of colonial agriculture, settlement, and hydraulic control in Lampung.

Once the road was completed, the irrigation project began. According to the *Programma* (1938) report, the project targeted irrigation for 3,000 bouw (±2,127 ha) with a flow rate of 35 m³/s; however, by the time of the system's inauguration, it was already serving 10,000 bouw (±7,090 ha) with a capacity of 21 m³/s. By the end of 1938, costs reached ƒ470,000 with plans for expansion to 30,000 bouw (±21,270 ha) and a budget of ƒ900,000; the long-term target even reached 55,000–60,000 bouw (±38,995–42,540 ha) with costs of approximately ƒ2,900,000. The dam was technically completed in February 1937, but was not officially inaugurated until September 21, 1938, by Governor-General Alidius Tjarda van Starkenborgh Stachouwer and his wife, who opened the first floodgate as a symbol of the flow of water toward the Sukadana colonization area. The ceremony was attended by colonial and indigenous officials, while the local community played a role only in the welcoming ceremony and gamelan performance, reinforcing the image of colonial technological success and the integration of the colonized region.

To understand the scale and technical economic implications of the Argoguruh project, planning, implementation, and expansion data are summarized comparatively in Table 1.

Table 1. Development of Targets, Realization, and Expansion Plans for the Argoguruh Irrigation Project (1935–1938)

Project Phase	Initial Target/Plan	Technical Implementation (1938)	Further Expansion Plan	Analytical Notes
Irrigation Area (bouw / approx. hectares)	3,000 bouw	10,000 bouw	30.000 to 55.000–60.000 bouw	Increase from 3,000 to 10,000 bouw realized by 1938; expansion planned up to 60,000 bouw
Water Flow (m³/s)	35 m³/s	21 m³/s	35 m³/s	Realized flow (21 m³/s) lower than initial target (35 m³/s)
Length of Main Channel	±12 km	±12 km (as built)	±75 km (including secondary)	Main channel built as planned; secondary network expansion planned
Project Cost (guilders)	ƒ93.250 (initial contract) + ƒ160.000 (dam) + ƒ70.000 (distribution)	±ƒ470.000 (through 1938)	±ƒ900.000 (30,000 bouw construction) to ƒ2.900.000 (maximum)	Total cost by 1938: ƒ470,000; further expansion estimated up to ƒ2.9 million
Labor	Mandatory migrant workers	Transmigrants + Garut laborers	Continuation of the colonial labor system	Labor composed of transmigrants and hired workers from Garut; mandatory work requirement

Source: De Indische Courant, 1937, 1938; De Locomotief, 1935; Gouvernement van Nederlandsch-Indië, 1938; Puspita et al., 2025

Table 1 shows that the Argoguruh irrigation project expanded considerably beyond its initial targets. The irrigated area grew from a planned 3,000 bouw to 10,000 bouw by 1938, with further

expansion envisioned up to 60,000 bouw. Total costs rose correspondingly, from an initial contract of ƒ93,250 to ƒ470,000 by 1938, reflecting the escalating scale of colonial investment. However, the realized water flow (21 m³/s) fell short of the initial target (35 m³/s), suggesting technical constraints or on-site adjustments.

This expansion accompanied a shift in cropping patterns: from rain-fed upland rice to irrigated paddy rice with wet-season varieties. While colonial sources presented this as a technical success, the project also served broader colonial objectives. According to Maassen (1937) and Sjamsu (1960), increased agricultural output was expected to generate taxable surpluses. In this system, irrigation infrastructure enabled the colonial state to stabilize rice production, expand taxable agricultural land, and secure a more predictable flow of agrarian revenue from the colonization zones. Thus, irrigation functioned as both a welfare measure for transmigrants and an instrument of fiscal extraction. Data from Sjamsu (1960) further qualify the scale of success: although colonial reports claimed 10,000 bouw of irrigated land by 1938, actual paddy fields in Sukadana in 1941 amounted to only 3,617 bouw, about 36 percent of the target. This gap between technocratic ambition and on-the-ground reality complicates the narrative of flawless colonial achievement.

Socio-Demographic and Economic Changes in the Sukadana Settlement Complex Following the Completion of the Way Sekampung Irrigation Project in Trimurjo–Metro

With the operation of the Way Sekampung irrigation system, major socio-economic changes reshaped the Sukadana settlement complex. The project increased agricultural production, expanded settlement areas, and accelerated the transformation of a region previously dependent on rain-fed agriculture. At the same time, irrigation functioned as part of the colonial Ethical Policy and transmigration program, making Argoguruh not merely a technical infrastructure project but also an instrument of colonial agrarian control. Through the regulation of land, labor, and water distribution, the colonial state influenced cropping patterns, settlement organization, and local economic activity (Puspita et al., 2025; Saputra & Setiawati, 2022). As a result, irrigation transformed not only farming systems but also the broader social and spatial structure of the region.

Socio-Demographic Changes

Fundamental changes following the operationalization of the Way Sekampung irrigation system are evident in the demographic patterns of settlement and spatial organization. With the irrigation system in place, the colonization area expanded along the water flow network. Early settlements likely followed proximity to rivers (river basins), particularly the Way Sekampung. Post-project, settlements developed rapidly along the routes of the artificial irrigation canals, with agricultural land systematically organized based on irrigation distribution.

The construction of this irrigation network also involved migrant workers as the primary labor force, primarily brought in from Garut. In practice, they helped dig canals and clear land through a semi-wage labor system, where they were paid in kind with rice and salted fish. This indicates that the irrigation project was not merely technical but also served as a means of mobilizing colonial labor (De Indische Courant, 1937; Valentino, 2025). This resulted in a more structured and expansive agricultural landscape compared to before.

The *Programma* (1938) report documents a visual map of the Sukadana Colonization Area following the expansion of irrigation, as shown in Figure 4 below. The map highlights major settlement concentrations in Trimurjo, Metro, and Batanghari, all of which developed along the expanding irrigation network connected to the Argoguruh system.

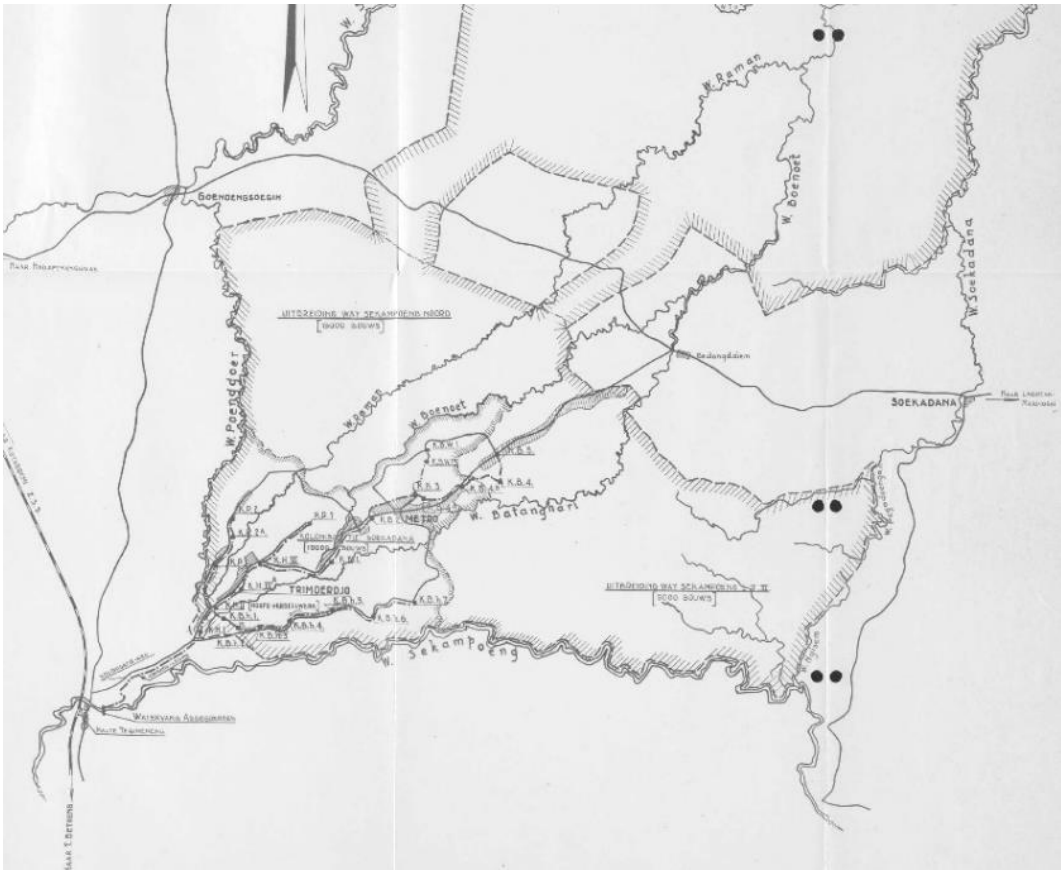


Figure 4. Map of the Sukadana Colonization Area in 1938 showing the Argoguruh Dam at the southwestern end, the main irrigation canals, and settlement clusters in Trimurjo, Metro, Batanghari, and surrounding colonization zones. The map demonstrates how colonial water management shaped settlement distribution by concentrating population and agricultural activity along controlled irrigation networks, a spatial legacy that persisted for decades.
Source: Gouvernement van Nederlandsch-Indië, 1938

In addition, the presence of irrigation also spurred the growth of social facilities such as markets, schools, and health services, as seen in the development of the Metro area, with the emergence of shops, clinics, and public schools (Nieuwe Apeldoornsche Courant, 1937). Thus, irrigation indirectly served as a catalyst for the formation of new social spaces during colonization.

Demographic changes were also evident in the rapid increase of Javanese transmigrants. In 1938, more than 4,000 migrants were settled in the Sukadana area (Trimurjo–Metro); by 1939, this number had risen to 5,500, an increase of approximately 37.5 percent (De Indische Courant, 1938). This influx gradually shifted the ethnic composition of the region. Although Dutch newspapers depicted harmonious relations between migrants and locals (Nieuwe Apeldoornsche Courant, 1937), other evidence suggests that transmigrants received privileged access to irrigated land, while local Lampungese communities faced growing competition for resources (Shadra & Subekti, 2025).

The long-term consequences of this unequal agrarian structure unfolded gradually. During the colonial period, tensions remained largely latent. However, after independence, as Javanese demographic dominance became more entrenched and land scarcity intensified, local grievances mounted. These accumulated pressures eventually contributed to the customary congresses of Palembang (1956) and Bukittinggi (1957), where Lampungese leaders called for a halt to further transmigration, citing land dispossession and the erosion of customary rights (Shadra & Ridhoi, 2025). Rather than directly triggering political conflict, the colonial irrigation and transmigration projects gradually produced demographic imbalance and unequal land access that continued to shape Lampung's postcolonial social dynamics.

Irrigation development not only altered cropping patterns but also generated distinctive new settlement structures. Colonists were not placed sporadically; instead, they were organized into units called *bedeng* (temporary barracks or settlement complexes). Colonial reports indicate that these settlement units were systematically numbered and arranged according to the irrigation network in the Sukadana colonization area (Gouvernement van Nederlandsch-Indië, 1938). Bedeng 1 (BD 1), located in present-day Adipuro, Trimurjo, became one of the earliest settlement nuclei, while the first colonists arriving in 1936 were accommodated in pre-prepared *bedeng* units (Pemerintah Kota Metro, 2002). Over time, these *bedeng* developed into permanent villages and structured settlement clusters following irrigation distribution patterns. The numbering system later survived in local memory and place naming, although many detailed identifications are now preserved primarily through local historical documentation and oral tradition.

Socio-Economic Changes

The supply of water from irrigation to the rice fields of the Trimurjo–Metro community significantly influenced the commodity economy. Before irrigation, the agricultural system was rain-fed and vulnerable to crop failure. Crops were limited to upland rice (padi gogo) and secondary crops such as peanuts and soybeans (De Indische Courant, 1937; Puspita et al., 2025; Valentino, 2025). After the dam began operating, irrigated rice became the priority crop. According to Puspita et al. (2025), rice cropping patterns in the Trimurjo colonization area shifted markedly between 1935 and 1941. Figure 5 illustrates the gradual transition from dryland to irrigated systems.

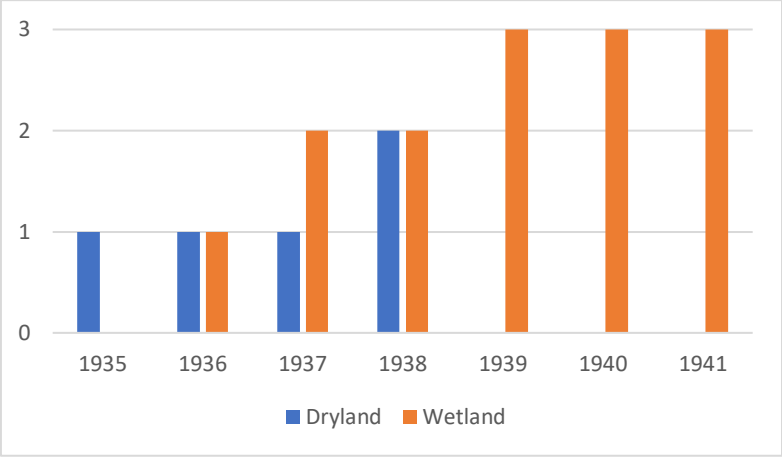


Figure 5. Changes in Rice Cropping Patterns in Trimurjo (1935–1941) Based on the Number of Cropping Cycles per Year. Source: Puspita et al., 2025

From 1935 to 1938, dryland rice (padi gogo) and irrigated rice coexisted. Beginning in 1939, upland rice was phased out entirely, replaced by irrigated rice with two to three harvests per year, coinciding with the full operation of the Argoguruh irrigation network.

At the regional level, the impact of irrigation on Lampung's rice trade is visible in colonial records. Table 2 presents the provincial rice balance sheet between 1935 and 1940, showing inflows (rice brought into Lampung from other regions), outflows (rice exported out of Lampung), and net balance.

Table 2. Lampung Rice Balance Sheet (1935–1940) in Metric Tons

Year	Inflows	Exports	Net
1935	1,827	14	+1,813
1936	615	3,116	-2,501
1937	3,428	2,054	+1,374
1938	3,243	848	+2,395
1939	399	6,464	-6,065
1940	3,100	20,305	-17,205

Source: Sjamsu, 1960

The data in Table 2 show that Lampung became a consistent net rice exporter after 1938, with exports peaking at 20,305 tons in 1940, the highest during the colonial period. However, this regional surplus did not necessarily translate into local prosperity for transmigrants. The negative net balance in 1936 and 1939 (indicating net imports) corresponded with pest attacks and crop failures, underscoring the fragility of local food security. Thus, while irrigation enabled regional surplus extraction, transmigrant households remained vulnerable to market fluctuations and ecological shocks. The expansion of irrigated rice production accelerated commercialization and increased transmigrants' dependence on traders, rice mills, and rural credit networks. Consequently, rising agricultural output also deepened rural indebtedness among colonists.

One consequence of this commercialization was the rapid growth of rural indebtedness. Debt records from the Lampung Colonial Bank reveal a darker side of irrigation-induced commercialization. Table 3 shows the rapid accumulation of debt among colonists.

Table 3. Colonial Debt of Transmigrants in Lampung (1935–1940) in Guilders (*ƒ*)

Year	End-of-year debt balance
1935	103
1936	325
1937	2.701
1938	21.373
1939	94.776
1940	114.692

Source: Sjamsu, 1960

Between 1935 and 1940, total unpaid loans surged from *ƒ*103 to *ƒ*114,692, a more than 1,100-fold increase. As Sjamsu (1960) observed, Chinese-owned rice mills "brought disaster to the colonists' livelihoods" through the *ijon* (pre-harvest selling) system, trapping migrants in debt cycles reminiscent of their former circumstances in Java.

The development of paddy farming and irrigation in Trimurjo–Metro continued into the New Order era, when Lampung was designated as a national Pelita project site due to its existing paddy field system and irrigation network. This continuity operated through several interconnected dimensions that embedded colonial legacies within postcolonial agrarian planning.

First, infrastructure continuity was evident in the continued use of colonial hydraulic systems. The Argoguruh Dam remained operational until at least the 1980s (Setiawan, 1984) and was rehabilitated and expanded rather than replaced. As a result, New Order agricultural development continued to depend on the spatial and technical logic established during the colonial period.

Second, agrarian continuity appeared in the persistence of rice-centered agricultural policies. The New Order's rice self-sufficiency (*Swasembada Beras*) program reproduced the colonial emphasis on irrigated rice monoculture and large-scale agrarian expansion. Lampung continued to function as a frontier of state-directed food production through transmigration, irrigation expansion, and the opening of new agricultural land, reproducing the colonial model of agrarian extraction.

Third, ecological continuity emerged through the accumulation of environmental degradation over time. Deforestation and hydrological disruption initiated during the colonial era intensified under New Order irrigation expansion. By the 1980s, the Way Sekampung watershed had been categorized as 'supercritical' due to severe erosion and sedimentation (Setiawan, 1984), reflecting how ecological degradation initiated during colonial expansion became structurally embedded within New Order development policies.

Finally, continuity was also visible in state development planning. Irrigation expansion relied heavily on foreign loans, echoing earlier colonial dependence on centralized state financing and large contractors. Projects such as the Batutegi Dam and swamp reclamation for transmigration followed the same top-down developmental logic as Rookmaaker's colonial colonization scheme. Thus, the modern agrarian system represented not a rupture from colonialism, but an institutional, infrastructural, and ecological continuation of colonial agrarian engineering (Grove, 1995).

The Socio-Ecological Impacts of the Way Sekampung Irrigation System in Terms of Continuity and Change from the Colonial Era to the New Order

This subsection analyzes the socio-ecological impacts of the Way Sekampung irrigation project from the colonial period to the New Order era. Using the framework of Green Imperialism (Grove, 1995), this study argues that the Argoguruh irrigation system not only transformed the environment during the colonial period but also established ecological and agrarian structures that continued and intensified after independence. To explain this long-term continuity, the study also applies the concept of path dependency, particularly regarding colonial infrastructure, land allocation, and irrigation-based agricultural expansion. In this context, New Order developmentalism did not replace colonial ecological engineering but expanded it through larger-scale irrigation, transmigration, and agrarian intensification.

The development of the Way Sekampung irrigation project in Trimurjo–Metro has, from the very beginning, brought about massive changes to the area surrounding the Way Sekampung watershed. In fact, these changes began even before the irrigation system was built, namely, with the clearing of land for transmigrant settlements from Java. Both the irrigation and transmigration projects have resulted in massive deforestation as their most tangible impact.

Clearing virgin secondary forest, coupled with the wet soil conditions in Central Lampung, was arduous work before a six-meter-wide path was finally opened connecting Trimurjo–Metro to the Argoguruh Dam and even as far as Telokbetong (De Indische Courant, 1937). In colonial reports, this process was often described as progress and the conquest of nature (Zentgraaff & Van Goudoever, 1936); however, when read critically, it constitutes a form of intensive ecological exploitation. The burning of grasslands, deforestation, and the draining of swamplands not only altered the vegetation but also affected the hydrological balance and soil fertility in the long term.

From an ecological perspective, large-scale deforestation during the colonial era marked the starting point of landscape transformation. Before mass transmigration and irrigation, the Way Sekampung region was still a forest (Hardjono, 1984) serving as a habitat for wildlife. In Zentgraaff's travel account (1936), South Sumatra at that time was a dense, untouched forest region where encounters with tigers, bears, and elephants were still common. The account mentions numerous cases of "man-eating" tigers attacking humans, as well as elephant herds frequently crossing settlements. Given that the year of these records (1936) was one year after the Sukadana penal colony was established (Gouvernement van Nederlandsch-Indië, 1938), this can be interpreted as an early indication of the disruption of wildlife habitats due to deforestation. This ecological degradation did not cease

during the colonial era. Entering the New Order era, agricultural intensification actually accelerated environmental damage. Although the World Bank report (World Bank, 1978) states that the impact of the irrigation project on the physical environment would be minimal because the land had been cultivated for years, the report contains a *development bias*. On-the-ground evidence tells a different story: in 1984, *Berita Yudha* reported that the Way Sekampung watershed had been classified as 'supercritical' due to high levels of erosion and sedimentation, indicating accelerated environmental degradation (Setiawan, 1984). The World Bank's developmental framework prioritized irrigation efficiency and agricultural expansion but paid limited attention to cumulative watershed degradation, deforestation, and long-term ecological vulnerability already visible in local environmental reporting. Ecological processes that began during the colonial era, such as deforestation and changes in water management, never recovered but continued to degrade alongside the expansion of irrigation systems during the New Order era.

Meanwhile, the socio-ecological impacts are evident in how uncontrolled human expansion creates a backlash against the environment and society itself. Although the traditional congresses of Palembang (1956) and Bukittinggi (1957) officially halted the mass transmigration program to Lampung (Shadra & Ridhoi, 2025), the New Order period actually witnessed a surge in *unassisted transmigration*, that is, migration undertaken without full government support.

Although budget-efficient, this faster population expansion proceeded with insufficient social and ecological control. Unplanned settlement patterns posed serious threats. By the late 1950s, Hardjono (1984) noted that unsystematic and excessive deforestation in Lampung had begun triggering floods. With a nearly continuous influx of self-initiated migrants over more than three decades, the frequency of flooding in this region continued to rise. This indicates that the ecological transformation triggered by colonial irrigation projects not only altered the natural environment but also created new conditions of vulnerability that directly impacted the lives of residents, both migrants and locals.

By the 1990s, agricultural intensification in Lampung had reached a large-scale and integrated level. By 1993, the area of rice fields had reached 188,383 ha with an irrigation network covering 262,783 ha, including the reclamation of 74,400 ha of swampland for productive agriculture (Harian Ekonomi Neraca, 1993). This project marked the beginning of *mega-scale development*, in which the conversion of wetland ecosystems was carried out on a massive scale to support transmigration and spatial reorganization. The Batutegi Dam became a symbol of state control over water resources. However, this technical success also accelerated the loss of wetland ecosystems and increased pressure on the watershed, reflecting a total ecological transformation that restricted the living space of natural systems for the sake of agricultural expansion. The comparison of data in Table 4 below provides a clearer picture of these dynamics of change.

Table 4 below not only illustrates technical developments but also reveals three main patterns: an escalation in scale from thousands to hundreds of thousands of hectares; the globalization of funding from the colonial state budget to World Bank and foreign loans, reaching 77%; and the intensification of ecological exploitation, from forest clearing to supercritical watersheds and total ecological transformation. In other words, irrigation development during the New Order era did not represent a new structural change but rather a continuation and intensification of the previous colonial patterns. While colonial-era interventions were limited to dam construction and land clearing for transmigrants, the New Order era saw a massive expansion of the system integrated with international capital, yet still within the framework of food production for the interests of the ruling center.

As Sjamsu (1960) documented, even Indonesia's Minister of Transmigration acknowledged in 1959 that 'the technical framework of implementation did not differ significantly' between Dutch-era colonization and postcolonial transmigration, an official admission that reinforces the institutional continuity at the heart of this study.

Table 4. Evolution of Irrigation in Way Sekampung Lampung (1930s–1993)

Period	Main Infrastructure	Irrigation Area / Target	Project Characteristics	Funding	Historical Implications
1935 (Colonial)	Argoguruh Dam	Approx. 20,600 ha in the initial plan	Colonial agrarian expansion	Dutch East Indies Government	Deforestation is the beginning of landscape transformation
1978 (early New Order era)	Rehabilitation of Argoguruh and the Batutegi and Segala Mider plans	32,400 ha up to a target of 73,000 ha	Rehabilitation and expansion of the system	World Bank: US$140 million (total project cost: US$216 million)	Colonial continuity and global integration
1984 (New Order)	Major rehabilitation and modification of the network	±50,900 ha (target increased)	Irrigation intensification	State budget plus foreign loans	Watersheds are becoming critical (high sedimentation) and have increased flood frequency
1993 (New Order continues)	Irrigation expansion and Batutegi	262,783 ha (total network)	Mega agricultural projects	77% foreign loans	Total ecological transformation

Source: Hardjono, 1984; Harian Ekonomi Neraca, 1993; Setiawan, 1984; World Bank, 1978

Thus, the success of the Argoguruh project spurred the influx of migrants and settlers into Trimurjo–Metro and the government's interest in developing paddy fields under the food self-sufficiency program. However, this also accelerated environmental degradation. Within the framework of *Green Imperialism* (Grove, 1995), colonialism not only transformed politics and the economy but also the tropical ecology through resource exploitation. The Argoguruh Dam illustrates this process through river regulation, deforestation, and wetland conversion undertaken to support rice production and agrarian control. This pattern continued after independence, becoming entrenched in New Order policies. The Way Sekampung Irrigation Project is not merely a product of infrastructure development but also part of an ongoing ecological transformation rooted in colonialism and continuing through the New Order era, with social and environmental impacts still felt today.

CONCLUSION

The Argoguruh Dam Irrigation Project was a major colonial irrigation achievement that increased agricultural productivity in the Sukadana–Trimurjo–Metro settlement area while simultaneously generating long-term socio-ecological consequences that persisted into the New Order era. This study demonstrates that deforestation, hydrological transformation, and the marginalization of local communities initiated during the colonial period were intensified through irrigation rehabilitation, transmigration expansion, and agrarian mega-projects such as the Batutegi Dam and wetland reclamation in the 1990s. As summarized in Table 4, this continuity was marked by the expansion of irrigation scale, increasing dependence on foreign financing, and the intensification of ecological transformation from the colonial period through the New Order era. Using Green Imperialism and path dependency as analytical frameworks, this study argues that New Order developmentalism did not represent a rupture from colonial ecological engineering but rather its continuation under a postcolonial state framework. Colonial infrastructure projects therefore need to be understood not merely as technical achievements, but as part of a long-term environmental history that reshaped both society and ecology in Lampung. This study also highlights the risks of rehabilitating colonial hydraulic systems without long-term environmental assessment, particularly in already degraded watersheds such as Way Sekampung. Nevertheless, the study remains limited by its reliance on literature-based sources and the absence of oral testimony or technical dam archives. Future research may extend this analysis into the

post-Reform era to examine how these socio-ecological legacies continue in contemporary Lampung. Ultimately, the Argoguruh Dam was not simply a colonial irrigation structure, but part of an enduring ecological transformation whose social and environmental consequences remain embedded in Lampung's landscape today.

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Author contributions

M. Nehza Rausan Shadra: Conceptualization, methodology, investigation (primary and secondary source collection), formal analysis, writing (original draft), writing (review & editing), visualization (tables and figures), project administration, data curation, validation. Muhammad Akmansyah: Funding acquisition, supervision. Nurnazli: Funding acquisition, supervision. All authors have read and approved the final manuscript.

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Availability of data and materials

All primary sources used in this study are publicly accessible via digital archives: *Delpher* (https://www.delpher.nl) for Dutch colonial newspapers, and the MPN Komdigi website for Indonesian local newspapers (*Berita Yudha* and *Harian Ekonomi Neraca*). Secondary sources (journal articles and books) are available from academic databases such as *Google Scholar*. The authors confirm that no new datasets were generated in the course of this research. For further inquiries, the corresponding author can be contacted.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

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Competing interests

The authors declare that they have no competing interests.

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