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Irrigation and Famine in Colonial India: A Case Study of the United Provinces (1817-1903)

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Abstract

This paper explores the relationship between irrigation policy, famine prevention, and colonial revenue priorities in the United Provinces of India between 1817 and 1903. Beginning with the famine of 1837, which triggered the construction of the Upper Ganga Canal, the study traces how canal-building evolved from a limited experiment to a major state enterprise. British officials publicly justified canals as protective works designed to mitigate drought and stabilise agriculture, yet their design, financing, and operation reveal a consistent emphasis on revenue extraction and the promotion of commercial agriculture. Using irrigation commission reports, famine commission proceedings, canal revenue data, and critiques by R.C. Dutt, Whitcombe, and Ian Stone, this paper analyses how protective and productive works were conceptualized, funded, and managed. The paper argues that irrigation policy under colonial rule was shaped by a dual objective: to secure political stability by reducing the risk of famine while ensuring that investments yielded fiscal returns. The introduction of canals expanded wheat cultivation and enhanced agricultural production, but also deepened market dependence and reinforced local hierarchies, as water distribution was often controlled by landlords and dominant castes. While canals reduced vulnerability to drought and created employment, they also produced ecological challenges such as waterlogging, soil salinity, and outbreaks of malaria. By situating canal construction within the wider political economy of empire, this study highlights how irrigation served both as a tool of famine relief and a mechanism of colonial control. These findings shed light on the structural tensions between revenue, relief, and agrarian resilience that defined British rule in northern India.

Keywords: Agrarian Economy, Canal Irrigation, Famine Prevention, United Provinces

Introduction

The history of irrigation in colonial North India cannot be separated from the recurring famines that marked the nineteenth century. The United Provinces (UP), earlier known as the North-Western Provinces, was among the region's most vulnerable to food scarcity. Famines in 1837–38, 1860–61, 1877–78, and 1896–97 caused widespread mortality, migration, and agrarian distress, forcing the colonial state to confront the limits of a monsoon-dependent agriculture. Irrigation was promoted as a remedy, and British administrators presented canals as protective works that would guard against drought and famine while demonstrating the modernizing role of the empire.

At the same time, irrigation was never only a humanitarian exercise. From the restoration of the Yamuna Canals in 1817 to the construction of the Ganga Canal in the 1840s and later projects such as the Agra and Lower Ganga Canals, canals were designed, financed, and assessed as investments. By the late nineteenth century, the government had formally classified irrigation into "productive works," expected to yield revenue, and "protective works", intended for relief. However, in practice, productive works received greater attention, reflecting the state's fiscal priorities. Cash crops like sugarcane, wheat for export, and indigo were encouraged, while subsistence grains received less emphasis.

This paper examines the tension between the rhetoric of famine prevention and the fiscal logic of irrigation policy in the United Provinces between 1817 and 1903. Drawing on famine commission reports, irrigation returns, government correspondence, and contemporary critiques such as those of R.C. Dutt, it argues that while canals were presented as safeguards against famine, their role in strengthening the colonial revenue system and commercializing agriculture was more significant. By situating irrigation within the political economy of empire, the paper highlights how water management embodied a structural tension between relief, revenue, and agrarian resilience.

Literature Review

The study of water management in the United Provinces during British rule has been explored extensively through both secondary and primary sources, which highlight the development, impact, and economic implications of canal irrigation. Elizabeth Whitecombe (1972), in *Agrarian Conditions in Northern India: Volume I*, critically assessed the effects of canal irrigation in the Ganga-Yamuna Doab, emphasizing its ecological and economic drawbacks. She argued that canals, being costly experiments, led to waterlogging, soil exhaustion, and increased famines due to the prioritization of cash crops over food grains. Whitecombe advocated the promotion of well irrigation as a more sustainable alternative.

Contrastingly, Ian Stone (1984) in *Canal Irrigation in British India* highlighted the technological advantages of canals over traditional irrigation methods. He noted that canals improved crop yields, stabilized harvest fluctuations, raised living standards, and supported limited industrial growth, reflecting a more positive assessment of canal irrigation. Similarly, RC Dutt (*India in the Victorian Age*) critiqued the British investment policy, arguing that excessive spending on railways, under the guise of famine relief, diverted resources from irrigation projects that could have alleviated food scarcity.

Robert B. Buckley (1890) provided detailed engineering and financial analyses of Indian irrigation works, documenting construction costs, operational conditions, and economic outcomes. Tapan Raychaudhry and Dharm Kumar (1983), in *The Cambridge Economic History of India*, examined the broader economic impacts of irrigation and traced changes in policy and funding mechanisms over time, highlighting the evolving nature of British irrigation strategy.

Primary sources further illuminate these discussions. The Indian Irrigation Commission Report (1903) emphasized the significance of irrigation and recommended major protective works, while also acknowledging the limitations of canal systems. Famine Reports of 1880 recorded the role of canals in mitigating drought effects and informed government decisions to expand

canal networks. The Revenue Report of the Ganges Canal (1856) by Smith R. Baird analyzed crop patterns and net revenue, explaining moderate returns in the canal's early years. PS Cautley's Report on the Ganges Canal (1854) detailed engineering challenges, labor, and material costs. Additionally, the *Statement on Moral and Material Progress and Condition of India* (1873, 1890) provided statistical insights into capital outlay, irrigated area, and revenue outcomes.

Collectively, these sources underscore the complex interplay between technological innovation, economic planning, and colonial priorities in shaping water management in the United Provinces. While secondary sources offer critical and comparative perspectives, primary reports provide empirical data on irrigation practices, financial returns, and administrative decisions, forming a comprehensive foundation for understanding British-era water management policies.

Research Methodology

This research uses a historical method to study how irrigation and famine were linked to the colonial economy in the United Provinces between 1817 and 1903. The main sources are official reports such as the *Famine Commission Report* (1880), *Irrigation Commission Report* (1903), the *Ganges Canal Revenue Report* (1856), and P.S. Cautley's *Report on the Ganges Canal* (1854), which provide data on costs, revenue, and irrigation coverage. Government records like the *Moral and Material Progress Reports* (1873, 1890), along with writings of R.C. Dutt and Robert B. Buckley, give further insights. Secondary works by Elizabeth Whitcombe, Ian Stone, Dharma Kumar, and others help compare different views. The study analyses these sources by looking at how canals were planned, how much money they made, how they helped during famines, and what problems they caused, such as waterlogging, salinity, and malaria. Both content and numerical analysis were used to compare protective and productive works. In the end, the conclusion was reached by weighing the advantages, such as increased cultivation, relief from famine, and revenue growth, against the disadvantages, like ecological damage and unequal access. In short, the clear success of canals in securing revenue and reducing famine impact outclassed their drawbacks.

Historical Background

The history of water management in India is deeply rooted in its civilization and cultural practices. Archaeological evidence from the Indus Valley Civilization demonstrates that early communities were adept at managing water through reservoirs, wells, and sophisticated drainage systems, such as those at Dholavira and Lothal. Across ancient and medieval India, kings, nobles, and temple authorities promoted irrigation by granting land and resources to construct tanks, embankments, and canals, recognizing irrigation as a vital function of statecraft for sustaining agriculture and revenue (Agarwal & Narain, 1997).

By the eighteenth century, India had a dense network of wells, tanks, bunds, and small canals, many of which continued to function despite political instability. These traditional systems protected communities against monsoon failures and localized famines (Mishra, 1994). However, the imposition of high colonial land revenue demands during the late eighteenth century disrupted these systems. The British prioritized maximizing revenue, often collecting

rents even during drought years. This burden impoverished rural communities, eroded their capacity to maintain traditional irrigation works, and contributed to the disintegration of village economies (Mishra, 1994, p. 25).

The East India Company gradually recognized the fiscal and protective potential of irrigation. Following the famine in Agra in 1803, which forced the remission of ₹3,00,000 in land revenue, the Company began to survey existing irrigation works, though its early efforts were fragmented (Bhanu, 1994). A turning point came with the restoration of the Western Yamuna Canal under Colonel John Colvin, completed in 1823. By the famine of 1837, this canal not only mitigated agricultural losses, saving crops valued at over 1.5 million pounds, but also produced significant revenue gains; collections rose from rupees 15,800 in 1828 to over rupees 4,20,500 in 1848. According to official reports, this produced a surplus estimated at 19% over total expenditure. (Dutt, 1904; Kumar & Desai, 1983).

This combination of famine protection and fiscal profitability convinced the colonial state to expand canal building. The Ganga Canal project was sanctioned in 1841 to irrigate the upper and lower Doab, despite initial cultural resistance and public health fears (Broich, 2007). By the late nineteenth century, canal construction was explicitly tied to a dual policy: stabilizing agrarian production to prevent social unrest and securing revenue through increased cash cropping (Bolding, Mollinga, & Van Straaten, 1995).

Thus, the colonial period marked a transition from community-managed irrigation to state-directed canal systems, setting the stage for the large-scale irrigation projects that reshaped the agrarian economy of the United Provinces between 1817 and 1903.

Early Colonial Policy and the Famine of 1837

Agriculture in the North-Western Provinces was almost entirely dependent on timely rainfall, and the failure of the monsoon frequently resulted in famine. Excessive land revenue demands aggravated agrarian distress, leaving cultivators with few resources to withstand drought years (Bhanu, 1956). The famine of 1837–38, often described as one of the most devastating in the region, enveloped much of the Doab and Bundelkhand, causing total failure of the *kharif* crop, the loss of grass and fodder, and a severe rise in food prices. Contemporary observers recorded harrowing scenes of hunger, migration, and death across Agra Division (Bhanu, 1956, p. 44).

The famine exposed the inadequacy of ad hoc relief efforts and pushed the colonial administration toward a systematic irrigation policy. In 1839, Governor-General Lord Auckland sanctioned surveys for a new canal from the Ganga, marking a policy shift toward constructing large-scale, state-sponsored irrigation works (Wilson, 1989). The idea originated with Colonel John Colvin but was taken forward by Captain Proby Cautley, who, despite technical challenges posed by the low-lying terrain, proposed a viable plan in 1840. The Court of Directors endorsed the project not merely for its fiscal promise but as a measure "calculated to contribute to the general improvement of the country" and to provide "security against famine and its attendant horrors" (Cautley, 1854, p. 46).

The construction of the Ganga Canal became a flagship enterprise. Despite opposition from Lord Ellenborough, who favored reducing expenditure and even modified the design to

prioritize navigation, Lord Hardinge's tenure revived the original proposal and made irrigation its primary objective (Cautley, 1854). Public concerns over health were addressed through one of the first government-sponsored studies on irrigation and malaria, which recommended drainage measures to prevent waterlogging (Kumar & Desai, 1983).

Completed in 1854, the canal was an engineering marvel stretching 350 miles from Haridwar to Kanpur with over 650 miles of distributaries, and was the first major irrigation work in northern India financed by loans raised in London, amounting to 3 million pounds (Stone, 1984). The first revenue report of 1856 indicated only moderate returns, but administrators remained optimistic, expecting that, as with the Yamuna canals, the project would soon convert its deficit into a surplus through both direct water rates and enhanced land revenue collections (Smith, 1856).

This period thus represents a crucial turning point in colonial policy: famine acted as both a humanitarian and political trigger, leading to the construction of a massive irrigation network designed to stabilize agrarian production and secure fiscal returns. The Ganga Canal became the prototype for subsequent canal-building activity in the North-Western Provinces, shaping irrigation policy well into the late nineteenth century.

Canal Irrigation and Crown Rule (1858–1866)

The revolt of 1857 marked a major turning point in both governance and public works policy in northern India. The North-Western Provinces and Oudh were among the most severely affected regions, suffering widespread devastation, depopulation, and agricultural decline (Roy, 2011). Irrigation infrastructure was not spared: canal installations were attacked, and local resentment against the operation of *rajbuhas* (distributary systems) on the Eastern Yamuna Canal contributed to rural disaffection (Kumar & Desai, 1983). After the rebellion was suppressed, the Crown assumed direct control over India, and irrigation policy became more centralized, systematic, and closely tied to fiscal planning.

Financially, the immediate post-rebellion years were challenging. Capital earmarked for irrigation under Lord Dalhousie's administration was diverted to military and administrative reconstruction, delaying further canal projects (McGinn, 2009). To address funding shortages, the Government experimented with private company participation between 1854 and 1867, mirroring the model used for railway construction (Stone, 1984). However, these ventures failed to deliver the expected results. Private schemes were largely confined to Madras and Orissa, and though they offered some returns, they did little to relieve the Public Works Department's financial burden. By 1864, with fiscal stability restored, the Secretary of State decided that irrigation works should once again become a state responsibility, financed through public loans (Whitcombe, 1972).

This period also saw an important intellectual development: the formal classification of public works. The Strachey Committee of 1858 divided projects into "State Works" (non-remunerative, such as courts or barracks) and "Works of Internal Improvement" (remunerative works expected to generate profit). Irrigation was placed squarely in the latter category and became the most important avenue for state investment (Kumar & Desai, 1983). However, financial records revealed mixed outcomes. When interest charges of 5% were added to capital

costs, only half of the eight major canals in the North-Western Provinces and Punjab showed a positive balance, with an overall deficit of Rupees 792,092, largely due to the underperformance of the Ganga Canal (Kumar & Desai, 1983).

The government therefore ordered the remodelling of the Ganga Canal in 1864. Three alternative proposals were prepared to correct its technical defects, including excessive declivity that had caused damaging erosion along the main channel. The most significant plan aimed to reconstruct sections of the main line to enable it to carry the full projected discharge of 6,750 cubic feet per second and improve distribution through a network of 2,266 miles of distributaries (Buckley, 1890).

Parallel to canal development, well irrigation continued to play a major role in the agrarian economy of the Doab. By 1861, there were an estimated 70,000 *pakka* (permanent) and 280,000 *kachha* (temporary) wells, irrigating nearly 1.5 million acres, roughly 15% of the cultivated area (Stone, 1984). These wells were particularly valuable during the *rabi* season, ensuring timely sowing and improved yields of wheat, barley, and other winter crops.

This decade thus laid the institutional and technical foundations for the major irrigation expansion of the later nineteenth century. It marked the transition from experimental private involvement back to centralized state-led canal construction, with a sharpened focus on fiscal profitability, engineering improvement, and classification of works. The remodelling of the Ganga Canal symbolized the government's determination to make irrigation both a famine-prevention measure and a financially viable enterprise.

Protective vs. Productive Works and the Famine Policy (1866–1878)

The decade following 1866 marked a decisive shift in British irrigation policy. For the first time, the Government of India committed itself to a sustained and predictable flow of funds for canal construction. Around 500,000 pounds annually was earmarked from ordinary revenue, supplemented by approximately 2 million pounds raised through public loans in London (Stone, 1984). This infusion of capital allowed the sanctioning of numerous large-scale canal schemes, both "productive" and "protective," involving an estimated outlay of £15 million over the next decade (Stone, 1984, p. 73).

Major irrigation works were now formally classified into two categories. ***Productive works*** were expected to yield significant fiscal returns by expanding cultivation and raising crop values so that water rates could cover construction costs and generate profit. ***Protective works***, on the other hand, were often unremunerative but deemed necessary to shield vulnerable regions from famine and ensure the stability of British rule (Mishra, 1994). The government recognized that irrigation had a dual role, creating employment during scarcity while providing long-term security against monsoon failure. The severe famine of 1877–78, which claimed nearly 1.35 million lives and cost 97.5 million pounds in relief, reinforced the need to prioritize famine protection over immediate profitability (Mishra, 1994).

In the North-Western Provinces, two major canal systems were initiated under this new framework. The Agra Canal, formally opened in 1874, commanded an area of 375,800 acres and had a summer discharge of 2,000 cusecs. Though its costs exceeded initial estimates, it

produced a return of 1% in 1877–78, partly due to increased water rates (Buckley, 1890). Similarly, the Lower Ganga Canal, sanctioned in 1872 and completed in 1879, added 1,060 km of main canal and 5,015 km of distributaries, irrigating nearly half a million hectares across Etawah, Kanpur, Mainpuri, Farrukhabad, and Allahabad (Buckley, 1890). Together, these canals significantly expanded irrigation coverage in the Doab.

Institutionally, this period witnessed the reorganization of the Public Works Department (PWD). In 1866, PWD was divided into military, civil (including irrigation), and railway branches, giving provincial governments more autonomy in execution while keeping policy oversight centralized through the Inspector-General of Irrigation and the PW Secretariat in Calcutta (Buckley, 1890). Sir Richard Strachey, appointed Inspector-General in 1867, introduced standardized procedures for canal design, water distribution, and assessment of irrigation charges, emphasizing the calculation of "irrigation duty" to maximize profits and ensure security of supply (Kumar & Desai, 1983).

The emphasis on financial returns and "secure" water supply encouraged the promotion of commercial cropping in canal tracts. Wheat, indigo, and sugarcane became the dominant crops, with wheat covering the largest irrigated area due to its higher yields and market value (Whitcombe, 1972). This commercialization had mixed consequences. On one hand, it generated reliable cash incomes that allowed cultivators to finance *rabi* crop production even when monsoon crops failed, thereby stabilizing local food supplies and employment (Stone, 1984, pp. 272–277). On the other hand, critics such as Whitcombe argued that canal policy should have favoured coarse grains like sorghum and millet to provide better famine protection. Instead, canal irrigation often prioritized exportable surpluses, contributing indirectly to food scarcities during famines (Whitcombe, 1972).

Environmental and public health challenges also became increasingly visible. Canal irrigation led to waterlogging, salinity *(reh),* and a higher incidence of fevers in certain districts. In 1878, the government commissioned H.B. Medlicott's enquiry into soil salinization, marking the first systematic investigation into the ecological effects of irrigation (Kumar & Desai, 1983).

Thus, the period from 1866 to 1878 represented the institutionalization of irrigation as both a fiscal and famine-prevention measure. While new canals like the Agra and Lower Ganga systems significantly expanded the irrigated area, the dual imperatives of revenue maximization and famine protection often produced tensions that shaped colonial water policy for decades to come.

Irrigation, Famine Commissions, and the Policy Shift (1878–1903)

The period between 1878 and 1903 was one of intense famine, heightened state intervention, and major institutional reforms in irrigation policy. The famine of 1877–78, which devastated Madras and Mysore, claimed an estimated 1.35 million lives and cost the government 9.75 million pounds in relief expenditure (Kumar & Desai, 1983). The Famine Commission of 1880, appointed in the aftermath, marked a turning point by explicitly recognizing irrigation as the foremost safeguard against famine. Its report stressed that the true value of canals could not be measured solely in terms of financial profit but must also account for lives saved, revenue preserved, and reduced expenditure on relief. It argued that irrigation not only prevented crop

failures in drought years but also raised agricultural productivity in normal years by enabling the cultivation of high-value crops such as wheat, rice, and sugarcane (Famine Commission Report, 1880).

Responding to the commission's recommendations, the government launched a more systematic irrigation program. Between 1880 and 1899, approximately Rupees 145 million was spent on productive irrigation works, with over 50% of this expenditure concentrated in the North-Western Provinces (Kumar & Desai, 1983). Crucially, the state also invested in protective works aimed at famine-prone areas, particularly Bundelkhand. The *Betwa Canal*, sanctioned in 1881 as India's first explicitly protective canal, was constructed partly as a famine relief project for the Jalaun district. Despite initially working at a loss, it ultimately became productive, commanding fertile tracts of alluvium (Stone, 1984). Plans for the Ken Canal, intended to serve the Banda district, were deferred to the early twentieth century, highlighting the limitations of protective irrigation in drought-prone but water-scarce regions.

This period also witnessed significant financial and administrative restructuring. From 1882–83, all major works were reclassified as "productive" (those expected to yield a minimum 4% return within ten years) or "protective" (those justified primarily on humanitarian grounds). At the same time, the government purchased private irrigation works in Madras and Orissa that had failed to meet guaranteed returns, tying up nearly 3.7 million pounds in unprofitable ventures (Kumar & Desai, 1983). Despite these outlays, railways continued to receive a disproportionate share of capital investment, reflecting the enduring priority placed on transport over irrigation for famine mitigation (Dutt, 1902).

The drought of 1896–97 dramatically altered the fiscal picture. In the North-Western Provinces, demand for irrigation surged, leading to a 77% rise in canal revenues and boosting net returns on capital invested in productive works to a record 6% (Kumar & Desai, 1983). However, the famine also exposed persistent gaps: the Ganges–Ghagra Doab remained largely without canal irrigation, and proposals for the Sharda Canal faced prolonged opposition from *taluqdars* and the British India Association, delaying its eventual completion until 1928 (Whitcombe, 1972).

The Irrigation Commission of 1903, appointed by Lord Curzon under the chairmanship of Sir Colin Scott-Moncrieff, marked the culmination of this period. The commission recommended the irrigation of an additional 10,200 square miles, with special attention to Bundelkhand and other drought-prone tracts. It also emphasized the role of private and small-scale works—particularly wells as complementary sources of irrigation. By 1901, private works accounted for nearly 60% of irrigated area in British India, half of it from wells. The commission recommended Rupees 7.5 million in grants and *takavi* loans to promote well irrigation, alongside reforms to make credit cheaper and more accessible (Indian Irrigation Commission Report, 1903).

This phase thus institutionalized a dual-track irrigation strategy: large state-funded canals in fertile tracts where water supply was abundant and financially viable, and smaller-scale works (both state-sponsored and private) in drought-prone areas where protective benefits outweighed immediate financial returns. The growing recognition of the social value of irrigation, however,

coexisted with the continuing emphasis on fiscal profitability, a tension that shaped the trajectory of colonial water policy well into the twentieth century.

Conclusion

Canal building in India began under the East India Company mainly as a way to increase revenue by bringing more land under cultivation. Lord Hardinge and other officials saw canals as tools to turn wastelands into productive land and to raise land revenue and water tax. The famine of 1837 showed that canals could also act as a protective measure, saving the state money on famine relief. This led to the construction of the Upper Ganga Canal, which opened in 1854. Although its revenue returns were lower than expected, it marked the start of a systematic irrigation policy.

British irrigation policy always carried two goals: protecting against famines and earning revenue. Canals were expected to stabilize agriculture, promote cash crops for trade, and maintain political stability, but they also had to pay for themselves. Historians debate whether this focus on cash crops caused food shortages. Whitcombe (1972) argued that the expansion of canal irrigation encouraged cash cropping, which often worsened the effects of famine by reducing the acreage under subsistence crops. In contrast, Ian Stone (1984) showed that foodgrain output, particularly wheat, actually increased in canal-irrigated areas and provided cultivators with some measure of security. In the United Provinces, wheat occupied a dual role: it was a lucrative cash crop sold in expanding urban and export markets, but it also functioned as a "fallback" food crop. This meant that in years of monsoon failure or drought, when more fragile crops like rice, sugarcane, or cotton were at risk, wheat grown with canal irrigation could still be harvested and consumed locally. For many peasant households, this created a buffer against starvation, as wheat could be diverted from the market to household subsistence. In this sense, canal irrigation did not simply shift cultivation toward commercial dependence but allowed wheat to straddle the line between market-oriented production and subsistence insurance, thereby moderating the severity of famine in irrigated districts. Water distribution was another issue. Local landlords and dominant castes often controlled canal outlets and *rajbuhas,* using them to their advantage even after the Canal Act of 1873 tried to regulate them. This showed that local power relations limited how fair the irrigation system could be. After the 1857 revolt, the government stopped using private companies and took direct control of canal construction. Frequent famines led to the building of protective works, especially in Bundelkhand, though these were not always profitable. By the 1890s, droughts increased the demand for irrigation, and canal revenues rose sharply, demonstrating the financial value of these works.

Canals brought both benefits and problems. They caused waterlogging, soil salinity, and health issues, but they also reduced dependence on monsoon rains, increased the cultivated area, and created jobs. More production meant higher incomes for peasants and higher revenues for the state. Overall, canal irrigation under British rule was both a tool for famine relief and a means of earning revenue. It changed the rural economy of the United Provinces, making it more productive but also more closely tied to markets and state control.

Thus, we can conclude that canals had more benefits than disadvantages, and they were an important and urgent need for a country like India, which was mainly dependent on agriculture and vulnerable to the uncertainty of the monsoon. By providing a steady and assured water supply, canals offered peasants greater certainty in cultivation, reduced the risks of crop failure, and supported both subsistence and cash crop farming. In short, the conspicuous success of the canals outclassed their drawbacks.

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