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# The introduction and impact of food crops in Taiwan during the Japanese colonial period

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This study explores the introduction and improvement of food crops in Taiwan under Japanese colonial rule (1895–1945) and their role in agricultural modernization. The colonial government introduced improved varieties, established experiment stations, promoted scientific cultivation, and expanded irrigation, transforming agricultural practices. Rice received the most systematic improvements, significantly enhancing yield and quality, while sweet potatoes became a vital food source amid rice exports. Sorghum, maize, and soybeans adapted to local needs, but wheat showed limited progress due to climatic and dietary constraints. Overall, crop introduction boosted productivity yet reinforced resource inequality and social stratification.

## KEYWORDS

Japanese colonial rule, Taiwanese agriculture, crop introduction, varietal improvement, influence

## 1 Introduction

### 1.1 Background

From 1895, when Japan formally occupied Taiwan under the Treaty of Shimonoseki, until Taiwan's retrocession in 1945, the island entered a crucial stage of modern history widely referred to as the "Japanese Colonial Period." During this half-century, Taiwan's agriculture underwent a gradual transformation from a traditional system toward modernization. This change not only profoundly reshaped the island's agricultural structure but also had lasting effects on subsequent economic development.

Following the First Sino-Japanese War, Japan incorporated Taiwan into its colonial governance system as a victorious power, making it an important colony and subjecting it to unprecedented social and economic changes during its 50 years of rule. During the Japanese period, the colonial government actively promoted a capitalist economic system, forcibly integrating Taiwan's economy into Japan's industrial chain, thereby creating a development trajectory markedly different from that of mainland China.

At the same time, Taiwan's agriculture suffered from the dual exploitation of the colonial authorities and Japanese capitalists, displaying distinct characteristics of a colonial economy. For example, in camphor production—regarded as an economically valuable resource—Japanese authorities promoted monoculture camphor tree planting and the camphor-processing industry, drastically altering Taiwan's original forestry structure solely to meet the exploitative needs of domestic and overseas markets.

This economically driven, monocultural development not only led to a sharp decline in forest biodiversity and ecological imbalance but also caused severe degradation of native forestlands, thereby undermining soil and water conservation and the long-term stability of the regional ecosystem.

Moreover, to more effectively extract and utilize local resources, the Japanese government implemented a series of agricultural improvement measures, including the introduction of advanced farming techniques, crop variety improvements, and infrastructure construction, which objectively improved agricultural productivity. Together, these policies and measures defined the basic characteristics of Taiwan's agriculture during the Japanese period. They reveal a new pattern of resource allocation and interest distribution under colonial rule, while laying a solid foundation for understanding the transformation of modern Taiwanese agriculture.

## 1.2 Research significance

The Japanese Colonial Period (1895–1945) was a pivotal stage in the development of Taiwan's agriculture and the transformation of its socio-economic structure. Under colonial rule, Taiwan became not only a testing ground for Japan's modern agricultural policies but also a site of profound change in the introduction and improvement of food crops.

The achievements of agricultural reform and technological innovation in post-Meiji Restoration Japan were systematically transplanted to Taiwan. Through large-scale rice variety improvements, the restructuring of the sugarcane production system, and the introduction and promotion of other crops, Taiwan's farming methods, crop structure, and management models gradually shifted toward modernization. This transformation significantly increased agricultural productivity, turning Taiwan into an important supplier of food and raw materials for Japan.

Meanwhile, the dramatic global political and economic upheavals—particularly the outbreak of the two World Wars—further strengthened Japan's control and exploitation of colonial agriculture. To meet wartime needs, the Japanese government integrated Taiwan into its wartime economic system, directing policy, resource allocation, and institutional adjustments to promote the concentrated production and export of strategic crops such as rice and sugar.

This mother-country-oriented agricultural development model, while increasing output and efficiency, also deepened social stratification and land concentration in Taiwan, leading to heavier burdens on farmers and frequent exploitation of labor.

Studying the introduction and improvement of food crops during this period not only reveals the trajectory and mechanisms of Taiwan's agricultural modernization but also sheds light on how colonial policy simultaneously boosted productivity and reshaped agricultural structures—while creating socio-economic tensions. This dual character provided the technical and institutional foundations for Taiwan's later agricultural modernization but also left a deep colonial imprint. Examining this historical process deepens our systematic understanding of Taiwan's agricultural and socio-economic development and offers valuable historical insights for optimizing contemporary agricultural structures and promoting regional economic coordination.

## 1.3 Theoretical framework

The theoretical framework of this study primarily involves colonial economics and the theory of agricultural modernization. Colonial

economics emphasizes how the colonial power constructs a one-dimensional dependent economic system through resource control and institutional design. In contrast, the theory of agricultural modernization highlights the role of technological innovation and institutional reform in enhancing productivity. The agricultural development of Taiwan during the Japanese colonial period exemplifies the intersection of these two approaches: on one hand, Japanese policies established the dependent agricultural structure of Taiwan as a colonial territory; on the other hand, technological and institutional innovations became key drivers of Taiwan's agricultural modernization. Based on this, this study explores the historical process and impact of agricultural modernization in Taiwan under Japanese colonial rule.

First, *The Application of Colonial Economics*: Colonial economics emphasizes how the colonial power integrates the economy of its colony into a one-dimensional system of dependence through resource control and institutional design. Japan's agricultural policy in Taiwan during the colonial period exemplified this logic. By exerting control over land, labor, and means of production, Japan deeply incorporated Taiwan's agricultural system into its own national economic structure. In particular, the production of key crops such as rice, sugarcane, and sweet potatoes was organized and regulated through land consolidation, strengthened production management, and market intervention, thereby reinforcing Taiwan's role as a food supplier for the Japanese metropole. Although agricultural productivity increased, the distribution of land and resources became severely unequal, and most Taiwanese farmers and laborers were deprived of the benefits of growth. This economic dependency not only led to land concentration but also intensified social stratification and class conflict, ultimately resulting in widespread social unrest.

### 1.3.1 Imperialist exploitation theory

Rooted in the Marxist–Leninist tradition, this perspective posits that colonial rule was essentially a mechanism for imperial powers to extract resources from their colonies. Scholars have noted that during the Japanese colonial period, Taiwan was treated as Japan's "supply base for food and raw materials" as well as a "consumer market for light industrial products" (Hsueh, 2005). Yanoihara Tadao and others, drawing upon Lenin's theory of imperialism, emphasized that Japan's monopoly capital restructured land ownership and modes of production, channeling the surplus value of Taiwan's traditional agriculture to Japan and accelerating the "proletarianization" of local farmers (Ke, 2006). From this perspective, the agricultural modernization promoted by the Japanese colonial government—such as the improvement of rice varieties—was not merely a matter of technological advancement, but a systematic redistribution of Taiwan's agricultural resources in service of Japan's economic interests.

### 1.3.2 Dependency theory and the core–periphery model

Dependency theory—represented by scholars such as André Gunder Frank and Samir Amin—emphasizes that the economic development of colonies was dominated by the metropole, forming a structural dependency between core and peripheral regions. During the Japanese colonial period, Taiwan was incorporated into a Japan-centered world economic system, in which agricultural policies and crop improvements primarily served Japan's export demands. Scholars have noted that research on Taiwan has long revolved

around a “development–dependence” paradigm (Ke, 2006), wherein Japan’s promoted economic growth was essentially built upon a dependency-based exploitation of Taiwan’s resources. For instance, the large-scale improvement and dissemination of high-yield rice varieties significantly boosted production, yet this was chiefly intended to stabilize Japan’s domestic market and military food supply, with profits and benefits remaining under the control of Japanese capital.

### 1.3.3 Colonial dual economic structure

During the Japanese colonial period, Taiwan exhibited a dual economic structure characterized by the coexistence of a cash-crop export economy dominated by Japanese capital and a residual traditional smallholder economy. According to Tu Chao-hsien, Japanese colonial authorities preferred to “preserve” and “utilize” the existing landlord system rather than abolish it outright, as a means to safeguard Japanese capital interests and allow the coexistence of local landlords and external capital (Tu, 1975). Within this framework, Japanese capital penetrated export-oriented sectors such as the sugar industry, while substantial household-based rice cultivation for subsistence was retained. In other words, although the colonial government promoted agricultural technology and productivity improvements, Taiwanese society continued to maintain a large proportion of traditional family farming, resulting in a coexistence between subsistence-based agriculture and capitalized plantation production (Ke, 2006).

### 1.3.4 Colonial modernization theory

The recently emerging perspective of colonial modernization argues that colonial development cannot be equated solely with exploitation. Some scholars suggest that while this theory does not deny the exploitative nature of Japan’s economic policies in Taiwan, it emphasizes the existence of institutional “gaps” within the colonial system that allowed the colonized population a limited degree of self-empowerment and participation in the modernization process (Lin, 2014). According to Lin Wen-kai and other researchers, although Taiwan achieved certain modernizing outcomes under colonial rule, the colonized people nonetheless had legitimate grounds to contest the structural inequalities in institutions and resource distribution (Lin, 2014). Overall, the agricultural development of Taiwan during the colonial period reflected both the progressive aspects of modernization and the negative consequences of class stratification and economic dependency.

In summary, this study draws upon classical theories in colonial economic history—such as the imperialist exploitation theory, dependency theory, dual economic structure model, and colonial modernization theory—to analyze the economic significance of the introduction and improvement of food crops in Taiwan during the Japanese colonial period. Collectively, these theoretical perspectives suggest that the Japanese colonial government, through its agricultural policies, reinforced Taiwan’s economic dependence on Japan. As a result, the achievements of agricultural modernization, while enhancing productivity, simultaneously served to support Japan’s economic system and to reallocate local social resources, thereby intensifying inequalities in resource distribution and deepening social stratification. The aforementioned scholars and literature provide the theoretical foundation for this study’s analysis of agricultural dependency and developmental logic under colonial rule.

Second, The Application of Agricultural Modernization Theory: The theory of agricultural modernization elucidates the role of

technological innovation and institutional reform in enhancing productivity. In the process of Taiwan’s agricultural modernization, the Japanese colonial government introduced new technologies, promoted improved crop varieties, developed infrastructure such as irrigation systems, and established agricultural research and experimental stations to increase crop productivity. Taking rice as an example, after three stages of varietal improvement, both the yield and quality of Taiwan’s rice increased significantly. However, this technological progress did not substantially improve the living standards of all Taiwanese people. Most of the high-yield and high-quality rice was exported to Japan or consumed by Japanese residents in Taiwan, while local farmers, constrained by export-oriented policies, were unable to access sufficient rice for domestic consumption and thus relied heavily on sweet potatoes and other coarse grains as staple foods. This situation exemplifies the phenomenon of ‘developmental exploitation’ within colonial agricultural policy—modernization enhanced productivity but failed to produce equitable social benefits.

By integrating the perspectives of colonial economics and agricultural modernization theory, this study reveals how the Japanese colonial government advanced the modernization of Taiwan’s agriculture through the reorganization of production structures, technological innovation, and resource allocation. At the same time, these processes intensified economic inequality and social stratification. This historical trajectory not only reshaped Taiwan’s socio-economic structure during the colonial period but also offers valuable lessons for contemporary agricultural and social policy development.

## 2 Introduction and improvement of food crops

During the 50 years of Japanese colonial rule in Taiwan, the introduction and improvement of food crops was a key factor in promoting the transformation of Taiwanese agriculture from traditional extensive cultivation to modernized farming. The colonial government introduced high-quality foreign varieties, established agricultural experiment stations, promoted scientific cultivation systems, and complemented these efforts with incentive measures and irrigation projects, thereby bringing about profound changes in both crop varieties and production methods. Different crops followed distinct paths of development and achieved varying degrees of success in the process of introduction and improvement: rice, as the staple food, received the most systematic and significant improvement; wheat, though incorporated into attempts at the rice–wheat triple-cropping system, remained difficult to popularize due to natural conditions and dietary habits; sweet potatoes, with their high yield and resilience, became an important food source for the Taiwanese people in the context of large-scale rice exports; sorghum and maize demonstrated adaptability and multi-purpose value in marginal regions; and soybeans, as a leguminous crop, played an important role in the supply of oil and supplementary foods.

### 2.1 Introduction and improvement of rice

#### 2.1.1 Introduction of foreign rice varieties (e.g., improved early- and late-season rice)

Before the Japanese colonization of Taiwan, the rice cultivated on the island mainly consisted of *indica* varieties introduced from

mainland China and Javanese-type varieties introduced from Southeast Asia, collectively known as “native rice” (*zilai dao*). These varieties were of poor quality, containing mixed grains such as red rice and black rice, resulting in low yields and inferior grain quality. According to the *Gazetteer of Taipei Subprefecture*,<sup>1</sup> a single *shēng* (about 1.8 liters) of brown rice could contain as many as 2,500–3,000 red rice grains, severely affecting its market reputation.

After Japan occupied Taiwan, rice seed improvement became the top priority for boosting grain production. Beginning in 1913, three successive rice seed improvement programs were implemented.

The first program (1913–1916) focused on removing impurities such as red rice to improve the purity of the grain (Nie et al., 2023).

The second program (1917–1918) built on the first by further screening and replanting high-quality seeds, which significantly improved grain quality (Nie et al., 2023).

Subsequently, Taiwan introduced a variety of new rice cultivars, including early-season and late-season types such as “Wutai,” “Yinzu Hong,” “Shuangjiang Zao,” “Round Grain,” and “Chike He,” as well as upland rice varieties such as “Qianghou,” “Linhe Ju,” and “Inland Rice.”<sup>2</sup> These varieties differed in maturity period, grain quality, and environmental adaptability, enriching the diversity of rice cultivated in Taiwan.

After 1921, the third rice seed improvement program was extended to areas such as Hsinchu and Miaoli, using surveys, screening, and seed exchange mechanisms to promote high-quality varieties. Following these improvements, Taiwan developed a new double-cropping rice system, and grain quality improved markedly.

### 2.1.2 Small-scale experimental planting and variety improvement trials

The Japanese colonial government established agricultural experiment stations and rice experimental fields throughout Taiwan to promote variety screening and improvements in cultivation techniques through small-scale trial plantings. From 1906 onward, rice yields increased year by year. In 1911, the Taiwan Governor-General’s Office expanded rice experimental stations to promote model cultivation, improve fertilization methods, and optimize management practices, thereby making double-cropping rice cultivation more scientific.<sup>3</sup>

In some areas, such as the Damugang Subprefecture in Tainan, triple-cropping rice was even tested,<sup>4</sup> taking advantage of abundant sunlight and favorable irrigation conditions to harvest rice three times a year. The success of these experimental fields demonstrated the effectiveness of dense planting, meticulous cultivation, and fertilizer management, thereby facilitating the dissemination of improved farming practices.

At the same time, research on the existing cultivation system led to the standardization of farming schedules, such as fixed sowing, transplanting, and harvesting times, as well as the introduction of scientific seed selection methods, including brine selection.<sup>5</sup> These changes marked the gradual transformation from traditional extensive farming toward intensive, standardized agriculture.

### 2.1.3 Government policy support and promotion (e.g., irrigation system construction)

The Taiwan Governor-General’s Office promoted rice cultivation improvement through incentive policies, farming guidance, and infrastructure development. Beginning in 1903, it implemented the “Brine Seed Selection Reward” (see footnote 3), subsidizing farmers to carry out seed selection and gradually popularizing high-quality rice. After 1910, model green manure fields were established<sup>6</sup> to promote leguminous green manure crops and improve soil fertility. Pest control rewards and educational workshops were also conducted to prevent and manage rice pests. Agricultural experiment stations further provided technical guidance to farmers.

In addition, the colonial government undertook extensive construction and renovation of irrigation works, improving water supply for paddy fields and expanding Taiwan’s rice-growing areas into the central and southern plains. As irrigation systems improved and fertilizer use became more widespread, double-cropping rice became the dominant cultivation system, with some areas even testing triple-cropping rice.

In the area of agricultural tool improvement, the colonial administration promoted and rewarded the use of deep plows and dehusking machines, enhancing production efficiency. Farmers’ associations and rice polishing plants were established, leading to the professionalization and scaling up of rice production. By the 1920s, both the yield and quality of rice in Taiwan had significantly increased, making rice cultivation the core of the colony’s agricultural economy (Taiwan Provincial Food Bureau, 1949).

In summary, during the Japanese colonial period, through the introduction of high-quality rice varieties, the promotion of experimental field improvements, the implementation of incentive policies, and infrastructure construction, Taiwan’s rice industry transformed from producing low-quality “native rice” to high-yield, high-quality double- and triple-cropping rice. This transformation laid the foundation for the modernization of Taiwan’s agriculture.

### 2.1.4 Promote green manure to improve soil fertility

During the Japanese colonial period, the Taiwan Government-General implemented an incentive policy for fertilizer improvement and established “model fields for green manure,” aiming to promote the use of green manure in agricultural production. According to *The Taipei Prefecture Gazetteer (Taihoku Chōshi)*, “In the Taipei Prefecture, rice paddies were often treated with green manure. Apart from rice fields, most lands were neglected, with only a few areas planted with cruciferous crops. Beginning in 1910, subsidies from the

1 Vol. 2, Taipei: Cheng Wen Publishing Co., Ltd., 1985, p. 320.

2 *Guide to Taiwan*, Taipei: Cheng Wen Publishing Co., Ltd., 1985, p. 28. Originally in Japanese, reprinted from the 1895 edition compiled by The Japan Miyako Newspaper Company, Irie Ei, & Miyagawa Jiro; translation by the author.

3 *Gazetteer of Taipei Subprefecture*, Vol. 2, Taipei: Cheng Wen Publishing Co., Ltd., 1985, pp. 318–319. Originally in Japanese, compiled by the Taipei Subprefecture, reprinted from the 1919 edition; translation by the author.

4 “Trial of Triple-Cropping Rice,” *Chinese Taiwan Daily News* (Taiwan), October 8, 1905, p. 4.

5 *Gazetteer of Taipei Subprefecture*, Vol. 2, 1985, p. 318.

6 *Overview of Chiayi Local Conditions*, Taipei: Cheng Wen Publishing Co., Ltd., 1985, p. 123. Originally in Japanese, compiled by Chiayi City Tamagawa Public School, mimeographed in 1933; translation by the author.

Government-General enabled farmers to establish model green-manure fields, primarily applying leguminous green manure, which produced remarkable results. Rice yields increased significantly, and the quality of harvested rice improved. Due to these positive outcomes, the promotion of green manure was further strengthened.<sup>7</sup>

The so-called “leguminous green manure” refers to the use of leguminous plants—such as *Sesbania cannabina*, *Astragalus sinicus* (Chinese milk vetch), and *Medicago sativa* (alfalfa)—as fertilizer crops. The roots of leguminous plants form symbiotic relationships with rhizobia, producing nodules that fix atmospheric nitrogen through biological nitrogen fixation, thereby converting it into nitrogen compounds that plants can absorb and utilize. This natural process not only reduces dependence on chemical fertilizers but also improves soil structure and enhances the fertility of paddy fields. Consequently, the promotion of leguminous green manure became a highly effective component of Taiwan’s agricultural improvement policies under Japanese colonial rule.

By 1917, the rice production situation in Taipei Prefecture was as follows: “A total of 48 model green manure fields were established, covering an area of approximately 378 acres. In addition, 30 alfalfa experimental fields were set up, covering an area of about 111 acres. In the model green manure fields, rice yields increased by 20%, while the increase in the alfalfa experimental fields reached 30%. Due to the recent surge in fertilizer prices, farmers reduced their spending on chemical fertilizers. Therefore, the incentives and promotion of green manure not only benefited the farmers but also significantly boosted rice production” (see footnote 7).

Chiayi County also achieved remarkable results in promoting the use of green manure: “The total area devoted to green manure cultivation, including both rice and dry rice fields, was approximately 140,531 acres, with a production volume of about 213,609,700 pounds, resulting in an average yield of approximately 21,826 pounds per acre. After the implementation of green manure incentive measures, the fertilizer needs of ordinary farmers were met through self-sufficiency” (*Chiayi Local Overview*, 1985, p. 123).

Taitō Prefecture also implemented similar policies: “The green manure incentive measures were introduced to address the severe depletion of soil productivity caused by long-term intensive cultivation of both lowland and highland areas by indigenous and settler populations. To resolve this problem, the government carried out a system of incentives for the use of green manure and compost in order to restore and enhance soil fertility.”<sup>8</sup>

The implementation of the aforementioned green manure incentive policies significantly enhanced the fertility of Taiwan’s agricultural lands. These measures not only contributed to increased rice yields but also ensured the long-term sustainability of agricultural production across the island.

During the Japanese colonial period, the production and distribution of fertilizers became a crucial factor in advancing the modernization of Taiwan’s agriculture, particularly in the cultivation of major crops such as rice and sweet potatoes. The supply of fertilizers depended not only

on governmental policy support but also on the importation of fertilizers, the improvement of local fertilizer production, and the establishment of efficient distribution networks. Through the introduction and regulation of fertilizer supply, the colonial government ensured that farmers had access to the necessary agricultural inputs—a policy that became especially significant amid the growing demand for higher agricultural productivity.

First, as Taiwan’s principal staple crop, rice production was highly dependent on the availability of fertilizers. The growth of rice requires sufficient nutrients—particularly nitrogen, phosphorus, and potassium—which are primarily supplied through fertilization. The colonial government, by introducing fertilizer incentive programs and promoting the use of green manure, partially substituted chemical fertilizers while improving soil quality and fertility, thereby enhancing rice productivity. In particular, in regions such as Taipei and Chiayi, the implementation of green manure cultivation and composting policies effectively restored soil fertility in paddy fields, resulting in significant improvements in both the yield and quality of rice.

Second, as one of Taiwan’s most important supplementary and staple foods, sweet potato cultivation likewise benefited from improvements in fertilizer production and distribution. As a root crop, sweet potatoes have relatively high demands for soil fertility, and the effective allocation of fertilizers ensured their stable growth even in less fertile soils. Particularly in contexts where large quantities of rice were exported, sweet potatoes became the primary food source for many local farmers. The promotion of green manure not only increased the organic matter content of the soil and improved its structure but also enhanced the crop’s resistance to pests and diseases, thereby improving both yield and quality.

Overall, the production and distribution of fertilizers played a crucial role in the modernization of Taiwan’s agriculture during the Japanese colonial period. Through institutionalized systems of fertilizer allocation and the widespread promotion of green manure, the government ensured the productivity of key crops such as rice and sweet potatoes. These efforts not only enhanced the yield and quality of major crops but also laid a solid foundation for the transformation and sustainable development of Taiwan’s agricultural sector.

## 2.2 Introduction and improvement of wheat

### 2.2.1 Introduction of wheat as a substitute food crop

Wheat cultivation in Taiwan began with the introduction of South China wheat by Han migrants, although the exact period is unclear. Chen Di’s *Dong Fan Ji* (Record of the Eastern Barbarians) from the Wanli era of the Ming dynasty records that Taiwan “has no wheat,” indicating that wheat cultivation was not yet common at the time. In the Qing period, sources such as the Imperially Commissioned Chronicle of the Pacification of Taiwan note that Taiwan “cultivates rice, wheat, and sweet potatoes, three harvests a year,” showing that wheat had become widely grown by the early Qing.

Before the Japanese occupation, wheat was mainly cultivated in dry fields in central and southern Taiwan, using extensive farming methods. Due to a lack of improved varieties and the prioritization of fertile land for sugarcane, the yield was low—only about 7 koku per hectare—resulting in low production efficiency (*Taiwan Provincial Document Committee*, 1972a).

7 The Taipei Prefecture Gazetteer (Vol. 2). (1985). Taipei: Cheng Wen Publishing Co., Ltd.

8 The Taitō Prefecture Survey (Vol. 2). (1985). Taipei: Cheng Wen Publishing Co., Ltd.

## 2.2.2 Government policy support and variety improvement

In 1917, the Taiwan Governor-General's Office launched the "Wheat Variety Improvement Campaign," which sought to enhance varieties through introduction, pure-line selection, and hybrid breeding. However, due to the policy protection of sugarcane cultivation and falling wheat prices, the results were limited, with improved varieties only promoted in poor coastal areas.

In 1922, Japanese agronomist Iso Eikichi proposed utilizing the winter fallow period of paddy fields to implement a "rice-wheat triple-cropping system" to resolve land competition issues (Taiwan Provincial Document Committee, 1972a). This system developed in four stages:

First stage (up to 1927): Both rice and wheat were local varieties, with overlapping growth periods.

Second stage: The early-maturing rice variety "Taichung No. 65" was promoted, shortening the rice production cycle, but wheat remained late-maturing local strains.

Third stage: Early-maturing wheat varieties such as "Saitama No. 27" and "Shōwa Early" were introduced, enabling timely rotation between rice and wheat.

Fourth stage: The development of fertilizer-tolerant and disease-resistant rice ("Taichung No. 150") and hybrid wheat varieties (e.g., "Taichung No. 31") resolved the growth period conflict completely.

In 1934, a major outbreak of wheat stem rust occurred, and in 1941, the successful breeding of the rust-resistant variety "Taichung No. 31" marked a significant breakthrough in wheat improvement (Taiwan Provincial Document Committee, 1972a).

## 2.2.3 Due to natural conditions and local dietary preferences, rice production remained dominant, while wheat cultivation failed to make significant progress

Although the Japanese colonial government implemented policies aimed at improving wheat cultivation and sought to promote its production through the introduction of new technologies and crop varieties, rice nonetheless remained Taiwan's dominant staple crop. Wheat cultivation faced multiple challenges that hindered productivity and prevented any significant breakthroughs.

First, local dietary preferences strongly favored rice, resulting in limited market demand and preventing wheat from gaining widespread acceptance. Second, Taiwan's climatic conditions—particularly its high humidity—were unfavorable for wheat growth, as excessive moisture made the crop more susceptible to pests and diseases. In addition, competition for arable land from the sugar industry posed another major constraint. The high profitability of sugarcane cultivation, combined with policy support, led to the allocation of vast tracts of farmland to sugar production, leaving little room for the expansion of wheat cultivation.

Data indicate that although the wheat cultivation area reached 1,857 *jia* (approximately 1,837 acres) in 1900, it sharply declined to 581 *jia* by 1926.<sup>9</sup> The drop in output was even more pronounced, falling from 72,000 *koku* in 1899 to merely 3,000 *koku* in 1927, illustrating the contraction of the wheat industry and its

marginalization within Taiwan's agricultural economy. The Japanese government attempted to revive wheat cultivation by introducing foreign wheat varieties and promoting a "triple-cropping system of rice and wheat," aiming to increase wheat production without reducing rice yields. However, due to weak market demand, competition for farmland from the sugar industry, and difficulties in implementing new technologies, this strategy failed to achieve the expected results.

## 2.3 Introduction and improvement of sweet potatoes

### 2.3.1 Widespread introduction and large-scale promotion as a staple and supplementary food crop

The sweet potato, originally native to South America, was introduced to China following Columbus's discovery of the New World and subsequently brought to Taiwan. Scholars hold differing views on the exact time of its introduction: one suggests that it was brought by immigrants from Zhangzhou and Quanzhou during the Jiajing reign of the Ming dynasty (1522–1566), while another attributes its arrival to the period surrounding Zheng Chenggong's (Koxinga's) occupation of Taiwan in 1661. By the early Daoguang reign of the Qing dynasty (1821), sweet potatoes were already widely cultivated throughout the island.

By the early years of Japanese colonial rule (1896), the cultivation area of sweet potatoes in Taiwan had reached more than 39,000 hectares. Owing to their ease of cultivation, minimal management requirements, and high yield, sweet potatoes became one of Taiwan's most important food crops. In the context of large-scale rice requisition and exportation to Japan under colonial policies, sweet potatoes served as the primary food source for the local population. According to *The Taipei Prefecture Gazetteer*, sweet potatoes were not only consumed as a supplementary food or substitute for rice but were also processed into starch, dried chips, and alcohol, while their leaves were used as fodder for livestock and poultry. The adoption of a biannual cropping system and their widespread promotion made sweet potatoes a cornerstone of Taiwan's food system.

### 2.3.2 The introduction of improved varieties significantly increased sweet potato yields

During the Japanese colonial period, sweet potatoes served as a vital staple crop in Taiwan, meeting the daily dietary needs of the local population for an extended period. However, the early varieties of sweet potatoes were generally inferior, characterized by low yields and unstable quality, which limited their significance in agricultural production. Recognizing the crop's potential within Taiwan's agricultural system, the Japanese colonial government began systematic efforts around 1922 to improve sweet potato varieties. These initiatives aimed to enhance both yield and quality, thereby positioning the crop as an increasingly important component of Taiwan's food supply amid mounting pressure on grain resources.

The colonial government conducted extensive comparative trials by introducing high-quality sweet potato varieties from mainland China, Japan, Okinawa, the United States, Java, and Borneo. Although some of these imported varieties demonstrated certain advantages during experimentation, they continued to face the dilemma of being either "high in quality but low in yield" or "high in yield but low in quality." This meant that while certain varieties achieved higher

<sup>9</sup> Taiwan Affairs (Vol. 24). (1985). Taipei: Cheng Wen Publishing Co., Ltd. (Reprint of the 1927 Japanese edition compiled by the Government-General of Taiwan; translated by the author), p. 308.

productivity, their quality failed to meet the expected standards—particularly in terms of market demand and food safety for local consumers. Consequently, despite the increased varietal diversity, the overall economic efficiency of sweet potato cultivation did not improve significantly.

After 1921, the Taiwan Government-General, through the collaboration between the Agricultural Experiment Station and its Chiayi Branch, successfully developed the “Tainong” variety of sweet potato, a superior strain combining both high yield and good quality (Chou, 1980, p. 499). These newly cultivated varieties not only achieved significantly higher productivity but also demonstrated strong adaptability when intercropped with sugarcane, greatly enhancing both the efficiency and diversity of agricultural production. The widespread adoption of the “Tainong” variety accelerated the elevation of sweet potatoes within Taiwan’s agricultural system, marking a major success in varietal improvement. Its dissemination helped farmers overcome the limitations of traditional sweet potato varieties, addressing issues of low yield and substandard quality.

According to statistical data, the cultivation area and yield of sweet potatoes increased from 39,855 hectares and 205,966 metric tons in 1900 to 134,715 hectares and 1,165,263 metric tons in 1945—representing 6.78- and 5.66-fold increases, respectively (Taiwan Provincial Food Bureau, 1951). As illustrated in Figures 1, 2, this significant growth reflects the remarkable effectiveness of the sweet potato varietal improvement policies. Compared with other agricultural products in Taiwan, the rise in sweet potato production was particularly notable. After 1937, due to the impact of Japan’s war of aggression against China, the output of most Taiwanese crops declined; however, sweet potatoes demonstrated strong resilience. Although the annual output in 1940 (1,512,420 metric tons) decreased by 111,681 metric tons compared with 1935 (1,624,101 metric tons), it still exceeded the 1930 level (1,329,902 metric tons) by 182,518 metric tons, highlighting the crop’s remarkable vitality.

Yet a critical question remains: was the increase in sweet potato production beneficial or detrimental to the Taiwanese people? To address this question, it is essential to consider the historical context. The Japanese colonial government promoted high-yield rice cultivation, but most of the rice produced was requisitioned and shipped to Japan or used as military provisions for Japan’s overseas wars. Consequently, the Taiwanese population was left to rely primarily on sweet potatoes for survival. In this sense, the apparent

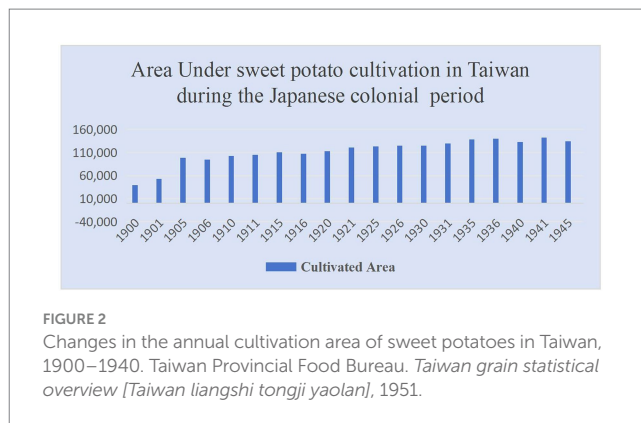


FIGURE 2 Changes in the annual cultivation area of sweet potatoes in Taiwan, 1900–1940. Taiwan Provincial Food Bureau. *Taiwan grain statistical overview [Taiwan liangshi tongji yaolan]*, 1951.

improvement in food supply through higher sweet potato production paradoxically reflected the deepening of colonial exploitation—more sweet potatoes meant that the colonial government could appropriate and export greater quantities of rice to Japan, rendering the local population increasingly dependent on this secondary staple for sustenance.

This process was not merely the outcome of varietal introduction and improvement but also reflected the comprehensive agricultural policies implemented by the colonial government. These policies included the dissemination of modern sweet potato cultivation techniques and the enhancement of irrigation systems. Supported by this multilayered policy framework, sweet potato productivity increased substantially, establishing the crop as an essential component of Taiwan’s food system. In particular, as large quantities of rice were exported to Japan, the role of sweet potatoes as a substitute staple became increasingly prominent, further underscoring their critical position within the colonial economy.

From the statistical data, the rapid increase in sweet potato production in Taiwan during the Japanese colonial period was primarily driven by Japan’s strong demand for sweet potato products. According to *Taiwan Trade Statistics for Fifty-Three Years* and other historical sources, Figure 3—compiled by the author—illustrates Taiwan’s sweet potato exports to Japan. The data show that in 1911, Taiwan exported only 106 metric tons of dried sweet potatoes to Japan, but by 1941 this figure had risen to 3,817 metric tons, representing an approximately 36-fold increase. Using 1938 as the peak year, exports reached 70,433 metric tons—about 664 times the volume of 1911. Although wartime transport constraints limited some aspects of trade, the overall growth trend remained highly significant.

Japan did not regard sweet potatoes as a dietary supplement but rather as an industrial raw material, widely utilized in the production of starch, alcohol, and fuel. This evidence demonstrates that sweet potato cultivation in Taiwan underwent a process of intense commodification under the colonial regime, with its development trajectory entirely subordinated to Japan’s industrial and military demands.

Overall, the improvement of sweet potato varieties not only advanced the development of agricultural production in Taiwan but also, through technological innovation and policy support, greatly enhanced the crop’s status within Taiwan’s social and economic systems. These developments made a significant contribution to the

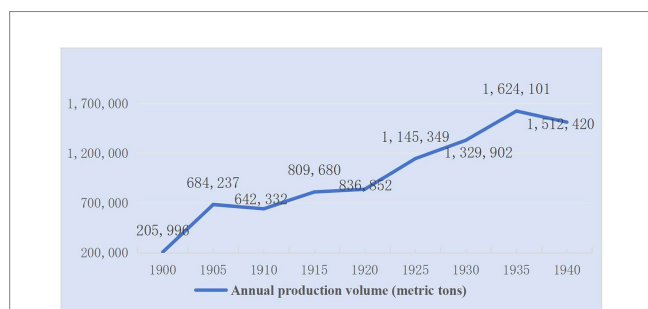
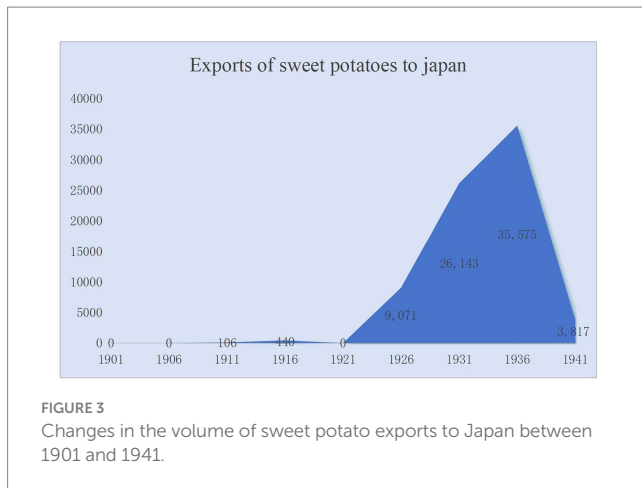


FIGURE 1 Changes in Taiwan’s annual sweet potato production from 1900 to 1940. Taiwan Provincial Food Bureau. *Taiwan grain statistical overview [Taiwan liangshi tongji yaolan]*, 1951. Reprinted from Chou (1980, p. 501).



stability and growth of Taiwan's agriculture during the Japanese colonial period.

### 2.3.3 The importance of sweet potatoes in agricultural production and the dietary patterns of the Taiwanese population

During the Japanese colonial period, the sweet potato became the island's second most important staple crop after rice, with cultivation extending across the whole of Taiwan—most intensively in the plains of Tainan, Taichū (Taichung), Kaohsiung Prefecture, and the central–western lowlands. Statistical data from Tainan Prefecture, Chiayi County, and Kaohsiung Prefecture show that sweet potatoes ranked alongside rice and sugarcane as one of the three principal crops of the region. They served as a common dietary staple for rural households and reached a peak of cultivation during the 1920s. Although yields in the Taitō (Taitung) area were lower than those of the western plains, sweet potatoes there nonetheless constituted an essential supplementary food source for the indigenous plains peoples (Pingpu), the Karyawan group, and Han settlers. Beyond their dietary function, sweet potatoes were widely utilized for industrial purposes such as starch and alcohol production, as well as for livestock feed, demonstrating their diverse agricultural value. By the final stage of Japanese rule, the sweet potato had secured its position as Taiwan's foremost starch crop, with per-unit yields exceeding those of most other coarse grains, making it an indispensable component of both the island's agricultural economy and daily subsistence.

Based on Zhou Xianwen's statistical data on the composition of staple foods among farming households in various regions of Taiwan in 1922, the author has organized and illustrated the findings in a chart (see Figure 4). From this, further analysis can be made regarding the characteristics of staple-food consumption in Taiwanese society during the Japanese colonial period. Overall, the majority of the island's inhabitants consumed mixed-grain meals composed primarily of rice and sweet potatoes, or relied mainly on sweet potatoes as their principal food source, while households that consumed rice as their primary staple were relatively few. This dietary pattern exhibited marked regional variation, with the proportions differing significantly across areas—variations that

were largely determined by the economic conditions of individual households.

More specifically, the proportion of households that regarded rice as their principal staple food was noticeably higher in Taipei, Taitō (Taitung), and Karenkō (Hualien), reaching 25, 25, and 40%, respectively—figures that stand in sharp contrast to those of other regions, where the proportion of rice-based diets remained below 10%. In contrast, when examining areas where sweet potatoes served as the main staple, it becomes evident that, with the exception of Hualien, most regions of Taiwan exhibited over 20% in this category, with particularly high concentrations in Tainan (71%) and Kaohsiung (61%). Viewed from another perspective—namely, the prevalence of mixed-grain meals combining rice and sweet potatoes as the primary staple—most regions reported rates exceeding 50%, except for Tainan (26%) and Kaohsiung (33%), where the corresponding proportions were relatively lower.

The formation of this dietary pattern was not the result of autonomous choices or personal taste preferences among the populace but was largely shaped by the unequal allocation of resources under colonial rule. Under the initiatives of the Japanese colonial administration, rice production in Taiwan indeed achieved remarkable progress through varietal improvement and the dissemination of modern agricultural techniques, leading to an overall increase in output. However, much of this growth primarily served the consumption needs of Japanese residents in Taiwan or was exported in large quantities to the Japanese mainland. Consequently, the amount of high-quality rice available for purchase by local Taiwanese residents was limited, and its market price remained prohibitively high, preventing most local inhabitants from making rice their principal staple food.

It is noteworthy that Japanese residents in Taiwan were more densely concentrated in areas such as Taipei, Hualien, and Taitung, where local inhabitants thus had relatively greater access to rice supplies. In contrast, other counties and cities, where the proportion of Japanese settlers was much lower and the population was predominantly composed of native Taiwanese, faced clear disadvantages in obtaining high-quality staple grains. Consequently, they were compelled to rely on sweet potatoes—an affordable and stable-yield alternative—as their primary food source. This situation not only reflects the structural inequality of resource distribution within the colonial economic system but also reveals a deeper issue: although agricultural modernization brought about technological advancements and increased productivity, its ultimate beneficiaries were not the colonized populace but rather the interests of the imperial metropole itself.

Therefore, it can be observed that although Japan's agricultural reforms in Taiwan ostensibly promoted the development of productivity, their underlying objective was a strategic deployment in service of Japanese militarism, rather than a genuine improvement in the living standards of local Taiwanese residents. This phenomenon exemplifies the inherent structural paradox of colonial agricultural modernization: the enhancement of production efficiency did not naturally translate into social equity or improvements in quality of life; instead, it often exacerbated wealth disparities and social inequalities within the colonial society.

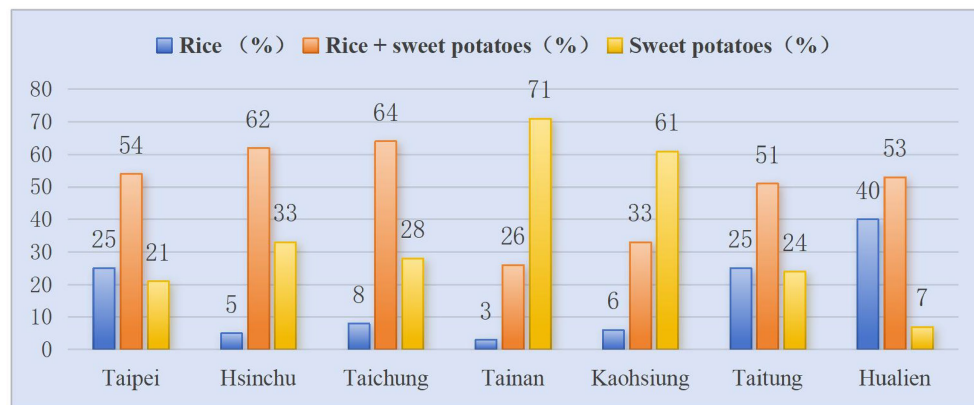


FIGURE 4 Percentage distribution of staple foods among farmhouse households in major regions of Taiwan Province, 1922 (Chou, 1980, p. 502).

## 2.4 Introduction and improvement of sorghum and maize

### 2.4.1 Introduction of sorghum and maize as coarse grains, particularly suitable for arid regions

Sorghum has a long history of cultivation in Taiwan. The *Gazetteer of Zhuluo County* from the Kangxi reign of the Qing dynasty records sorghum cultivation and uses, noting that its grains are larger than millet and can be categorized into glutinous and non-glutinous types, used, respectively, for brewing alcohol and making cakes or porridge.<sup>10</sup> The *Record of a Mission to Taiwan (Taihai Shicha Lu)* from the first year of Qianlong notes that, because the Penghu Islands have sandy soils and strong sea winds unfavorable for rice cultivation, sorghum became an important local staple (Shujing, 1983). The *Gazetteer of Penghu Subprefecture* further details its varieties, uses, and cultivation methods, noting that sorghum served not only as a staple grain but also as a raw material for brewing and as fuel.<sup>11</sup> Additionally, the *Gazetteer of Kavalan Subprefecture* contains records indicating that sorghum was widely distributed in northern and central Taiwan.<sup>12</sup>

Maize, introduced into China after Columbus's discovery of the New World, was also brought to Taiwan relatively early, primarily as local flint varieties in yellow and white types. Although Qing-era sources lack systematic records of maize cultivation, by the Japanese colonial period, maize had become one of Taiwan's important coarse grain crops, particularly suited to the eastern and more arid regions.

### 2.4.2 Promotion of improved seeds and cultivation techniques

During the Japanese colonial period, the Government-General of Taiwan actively promoted and improved the cultivation of sorghum and maize. The cultivation methods for sorghum gradually became more standardized. The *Comprehensive Gazetteer of Taiwan Province* provides detailed documentation of its sowing techniques—both drill and hill planting—as well as methods for thinning and fertilization. The recommended row spacing was 60–75 centimeters, with 5–6 seeds sown per hill. The first thinning was conducted when seedlings reached 15–18 centimeters in height, and the second at 24–27 centimeters, leaving 2–3 plants per hill. Fertilizers such as compost, superphosphate, and mugwort ash were used as base fertilizers, while ammonium sulfate served as a topdressing. Sorghum typically matured in mid-July, and because of frequent typhoons, farmers would bind the leaves together to enhance wind resistance (Taiwan Provincial Document Committee, 1972b).

In terms of pest and disease control, smut, downy mildew, and insect pests such as the grain moth and corn borer posed major threats to sorghum cultivation. Through varietal improvement and the dissemination of advanced cultivation techniques, the yield of sorghum in Penghu increased steadily—from 3,600 jin per *jia* in 1925 to 3,517 jin in 1934—reflecting gradual enhancement in production efficiency (Sugiyama, 1926/1985).

During the Japanese colonial period, the cultivation of maize in Taiwan expanded steadily. In 1928, the total area devoted to maize was approximately 800 hectares; by 1940, it had increased to more than 2,600 hectares, marking the highest level of maize cultivation during the entire colonial era. In 1942, Taiwan's annual maize production reached 44,331 *koku*, setting a record high for the period. In terms of regional distribution, Taitung County was the principal production area, followed by Chiayi, Yunlin, and Hualien (Taiwan Provincial Document Committee, 1972b, p. 67).

Taking the Penghu Islands as an example, although the annual maize yield fluctuated slightly, it exhibited an overall trend of steady growth. In 1928, Penghu's maize output amounted to 960 *shi* (with one *shi* equivalent to approximately 56 kilograms during the colonial period); in 1931, it rose to 1,037 *shi*, and peaked at 1,077 *shi* in 1933. Thereafter, production

10 Zhou Zhongxuan (Ed.), Chen Menglin (Comp.), *Gazetteer of Zhuluo County*, Vol. 10, Taipei: Cheng Wen Publishing Co., Ltd., 1983, Vol. 3, p. 188.

11 Lin Hao (Comp.), Xue Shaoyuan (Rev.), *Gazetteer of Penghu Subprefecture*, Vol. 10, Taipei: Cheng Wen Publishing Co., Ltd., 1983, Vol. 2, p. 757.

12 Chen Shujun (Comp.), Li Qisheng (Cont.), *Gazetteer of Kavalan Subprefecture*, Vol. 6, Taipei: Cheng Wen Publishing Co., Ltd., 1983, Vol. 3, p. 244.

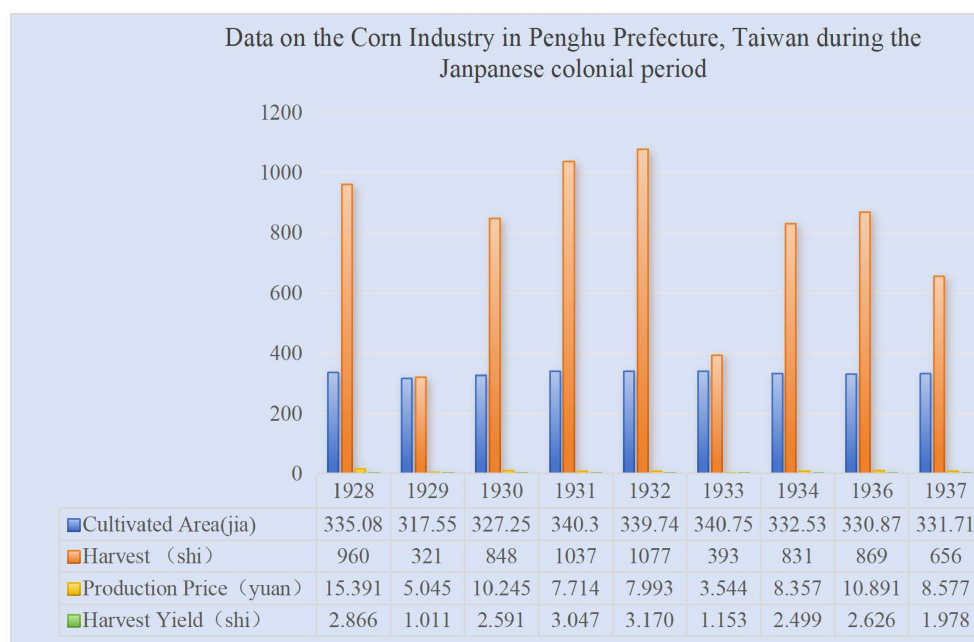


FIGURE 5

Major Data on the Corn Industry in Penghu Prefecture, Taiwan during the Japanese Occupation Period (1928–1937).

declined slightly to 831 *shi* in 1934, 869 *shi* in 1936, and 656 *shi* in 1937, as shown in Figure 5 (Penghu Administrative Office, 1928–1932)

### 2.4.3 Diverse uses of sorghum and maize (e.g., feed, food, and industrial raw materials)

As coarse grains, sorghum and maize were not only supplementary foods for the population but were also widely used as animal feed and in industrial production. Glutinous sorghum varieties were used for brewing alcohol, while non-glutinous varieties were made into cakes, porridge, and other foods. Sorghum stalks were commonly used as fuel or for making brooms. Maize was consumed directly but was also a major feed crop for pigs and poultry, and its starch served as an industrial raw material.

Overall, during the Japanese colonial period, the promotion and improvement of sorghum and maize were concentrated in arid, low-rainfall, and marginal areas. Penghu became the core production area for sorghum due to its climate and soil constraints, while maize cultivation expanded in eastern and south-central Taiwan. Although neither crop replaced rice as the primary staple, their value as feed, industrial raw materials, and supplementary foods made them indispensable components of Taiwan's agricultural system.

## 2.5 Introduction and improvement of other coarse grains

Taking soybeans as an example, as an important source of protein, soybeans have significant economic value in Taiwan's agricultural production and are widely used in the production of oilseed crops.

Soybeans (*Glycine max*), a leguminous plant native to China, were among the earliest domesticated crops in the country and are widely cultivated throughout various regions. They can serve both as a grain crop and as an oilseed crop, with uses spanning food processing (such as tofu, soy sauce, and soy milk), industrial products (such as fertilizers), and animal feed. The introduction and cultivation of soybeans in Taiwan have a long history; records indicate cultivation as early as the Yuan dynasty. The *General Gazetteer of Fujian* from the Qing period explicitly identifies soybeans as one of the important economic crops in Taiwan.

During the Japanese colonial period, Taiwan had a diverse range of soybean varieties, with common types including “Pearl Bean,” “White Bean,” “Black Bean,” and “Green-Skinned Bean.” Soybean production was primarily concentrated in the southern regions, particularly in Tainan, Kaohsiung, and Taichung, where climatic conditions were favorable for soybean growth. According to statistics, Taiwan's soybean planting area in 1900 and 1928 was 11,365 *jia* (approximately 165,360 mu) and 2,285 *jia* (approximately 33,246 mu), respectively.<sup>13</sup>

The primary cultivation method involved sowing in spring and harvesting in autumn, with planting times varying slightly by region but generally showing a pattern in which southern areas began planting earlier than northern areas.

<sup>13</sup> *Overview of Inspections Across Taiwan*, Vol. 1, Taipei: Cheng Wen Publishing Co., Ltd., 1985, p. 13. Originally in Japanese, compiled by Obe Nakaei, printed in 1930; translation by the author.

## 3 Analysis of the factors influencing the introduction and improvement of food crops in Taiwan during the Japanese colonial period

### 3.1 Natural factors

#### 3.1.1 Geography and hydrology

Taiwan's topography is dominated by mountainous terrain, which covers about two-thirds of its total area. Most agricultural production activities are concentrated in the western alluvial plains, including the Chianan Plain, Pingtung Plain, and the Yilan Plain in the northeast. The Central Mountain Range runs through the island, forming a significant natural barrier that limits east–west transportation and restricts the amount of arable land suitable for agricultural development. This geographic reality prompted agricultural production to gradually expand into plateaus and hilly areas.

The western coastline is relatively straight, but significant sediment deposition causes many ports to silt up; for example, Anping Port's functions were limited by sedimentation, while Kaohsiung Port, after extensive artificial improvements, became capable of handling bulk shipments of imported crop seeds. In contrast, the faulted coastline of the east generally lacks good harbors, which to some extent limited the efficiency and scale of introducing foreign crops.

Taiwan's rivers are generally short and have rapid currents, such as the Zhuoshui River and Gaoping River. During the rainy season, these rivers often flood and damage farmland, while in the dry season they may run dry, resulting in insufficient water supply and long-term instability in irrigation systems. Natural lakes are few, limiting overall water storage capacity, and per capita available water resources are only about one-seventh of the global average. Influenced by regional climate, hydrological characteristics display marked spatial and seasonal unevenness—floods in summer and droughts in winter. To secure the introduction, promotion, and stable production of major crops such as rice, the Taiwan Governor-General's Office successively constructed major water infrastructure projects, such as the Chianan Irrigation System, which improved irrigation conditions, enhanced land use efficiency, and effectively promoted sustainable regional agricultural development.

#### 3.1.2 Land quality and water resource distribution

Taiwan's land types are diverse, ranging from fertile plains to leached soils in mountainous areas, providing varied planting conditions. Land quality directly affects crop growth: plains are particularly suitable for crops with high water requirements, such as rice and soybeans, while mountainous areas are better suited to drought-tolerant crops with strong adaptability to upland conditions. Water resources are unevenly distributed; in mountainous areas, rivers are short and rapid, making them unsuitable for navigation, which adds pressure to agricultural irrigation and the transportation of agricultural products.

### 3.2 Policy factors

#### 3.2.1 Colonial government agricultural policies

The agricultural policies of the Taiwan Governor-General's Office played a major role in promoting the modernization of Taiwan's

agriculture. Through the implementation of agricultural improvement programs, technical extension, and financial support, the colonial government actively advanced agricultural intensification and modernization—particularly in the cultivation of rice, wheat, and coarse grains such as sweet potatoes and maize. By effectively managing land and water resources, the government promoted large-scale agricultural production. Through land expropriation and redistribution, it not only ensured stable food production but also reinforced centralized resource management, further strengthening political control over agriculture.

#### 3.2.2 Introduction and improvement of agricultural technology

The Governor-General's Office encouraged the introduction of foreign crops and improved varieties, implementing standardization in agricultural cultivation techniques. In the realm of technology transfer, it especially emphasized improvements in rice cultivation methods. Wheat also received technical support, and although Taiwan's natural conditions were not entirely suitable for wheat, it remained an important food crop. The government made significant efforts in promoting modern agricultural technology and improved varieties to increase crop yields and enhance agricultural efficiency.

#### 3.2.3 Wartime needs and food policies

During wartime, to ensure Taiwan's food supply, the Governor-General's Office implemented strict food policies. The government exercised tight control over food production and distribution, ensuring Taiwan served as a logistical base for Japan's food supply. In rice cultivation and other staple crops, the government intensified production planning and management to meet wartime food demand. These policies not only stabilized food supply but also fostered further growth in Taiwan's agricultural output.

### 3.3 Economic and social factors

#### 3.3.1 Japan's demand for Taiwanese agriculture and the transformation of the market economy

During the Japanese colonial period, Japan's demand for Taiwanese agricultural products spurred the transformation of the market economy. As Taiwan was gradually integrated into Japan's economic system, its agriculture became closely linked to the domestic Japanese market. Through policy interventions and the promotion of agricultural technology, the Japanese government required Taiwan to expand production of food crops—particularly rice, sweet potatoes, and other coarse grains—thereby reshaping the structure of Taiwan's agricultural industry.

#### 3.3.2 Changes in population and labor force

During the Japanese colonial period, Taiwan experienced sustained population growth, with both migration and natural population increase providing an abundant labor force that became a crucial driving factor for agricultural development. As the number of immigrants rose, agricultural productivity improved significantly, particularly in the large-scale cultivation of staple food crops. The ample supply of labor ensured the scalability and efficiency of agricultural production.

While the increase in population and labor force contributed to the development of Taiwan's grain industry, it also gave rise to numerous social problems during the Japanese colonial period. The colonial government, through strict management and the exploitation of labor, advanced the modernization of Taiwan's agriculture, achieving remarkable growth particularly in the production of major crops such as rice, sugarcane, and sweet potatoes. However, this growth was largely built upon low wages, forced labor, and harsh working conditions. Farmers and laborers were compelled to work long hours under intense physical demands—especially during rice transplanting, harvesting, and sugarcane cutting seasons—often laboring from dawn until dusk for meager compensation. Through rigid control over land and labor, along with compulsory task assignments and punitive enforcement mechanisms, the colonial administration maintained a system of sustained exploitation of the agricultural workforce.

The Japanese colonial government implemented a high-density system of population management and social control in Taiwan's rural society through the strict enforcement of the *Bojia* system and household registration surveys. It regularly mobilized farmers to participate in various public construction labor, including irrigation projects, road building, and the construction of Shinto shrines. For instance, between 1928 and 1930, the colonial administration organized indigenous groups to engage in forestry development and shrine construction projects in the mountainous areas. This not only disrupted their traditional agricultural and hunting rhythms but also often resulted in the deduction of food expenses from labor compensation, with some cases even involving forced donations. Overall, Taiwanese laborers during the colonial period were generally paid low wages, significantly lower than those of Japanese workers, and structural wage disparities were evident. Research indicates that although Taiwanese people constituted the majority of the labor market, the average wage of Japanese workers was approximately double that of their Taiwanese counterparts. Under a low-wage system combined with long working hours, those engaged in farming or agricultural labor often worked from dawn until dusk, laboring diligently, but earned only meager financial rewards.

The exploitation inherent in this labor system directly exacerbated the suffering of the grassroots population. The land on which farmers depended for their livelihoods was heavily consolidated by a few Japanese immigrants and local large landowners, leading to a high concentration of land ownership. The traditional tenant farming system during the colonial period not only failed to improve but actually became more oppressive due to widespread land consolidation and high land rents. Given the limited land and dense population in Taiwan, most tenancy agreements were based on verbal contracts, with short lease terms, high deposits, and exorbitant rents, creating a typical “unequal tenancy structure.” Although the colonial government established tenant farmer organizations in 1922, their effectiveness was limited and failed to improve the situation of farmers. As a result, a large number of small farmers lost their land and were forced to become tenants or day laborers with meager incomes, living in poverty. The colonial government showed little genuine concern for the rights of small farmers, leaving the lower classes in a

prolonged state of oppression and exploitation, accumulating deep dissatisfaction and trauma. Overall, the gap between rich and poor in rural areas widened significantly, with Japanese and local large landowners and colonial bureaucrats controlling the majority of land and wealth, while the vast grassroots population became trapped in a vicious cycle of deteriorating health and debt.

The unequal economic structure continuously intensified social conflicts and sparked a series of waves of resistance. The “Erlin Incident” of 1924–1925 serves as a typical example: sugarcane farmers in the Erlin region of Changhua, dissatisfied with the extremely low prices at which the sugar factories purchased sugarcane, collectively protested and clashed violently with the factory management. Such events highlighted the anger and consciousness of resistance among farmers who had long been deprived of their earnings under the colonial economic system. At the same time, the colonial government's forced labor policies and cultural oppression also triggered armed resistance among indigenous peoples. Historical records indicate that, after being deprived of their traditional livelihoods such as hunting, many indigenous people were forced into labor as mountain workers or domestic servants for the Japanese, enduring long-term discrimination and abuse, which led to deep resentment toward the colonial rule. The Wushe Incident of 1930 was a direct result of the long-standing oppression and accumulated discontent. The continuous mobilization for “public service,” wage deductions, and forced donations further fueled indigenous resistance. Additionally, from the mid-1920s, a wave of farmer movements emerged across the island, with farmers' associations and farmers' congresses being established to demand improvements in labor conditions and economic treatment. This social awakening not only revealed the deepening class conflicts under the colonial system but also reflected the collective reflection and resistance of the lower laboring classes against systemic exploitation.

### 3.3.3 Dietary habits and culture

Taiwan's traditional dietary habits were heavily influenced by climate and geography, with rice long serving as the staple food. However, with the colonial government's promotion of alternative crops such as sweet potatoes, dietary patterns began to change. In southern Taiwan in particular, sweet potatoes gradually became an important supplementary food, and in some areas they became one of the staples. The colonial food policies accelerated this change and hastened the transformation of Taiwan's dietary culture.

### 3.3.4 Influence of agricultural culture

Taiwan's agricultural culture was shaped by the integration of Han Chinese and indigenous traditions, particularly in the cultivation of coarse grains such as sorghum and maize. The combination of traditional agricultural knowledge and Japanese-introduced modern farming techniques promoted diversified agricultural development. This cultural integration not only improved agricultural productivity but also laid the foundation for the diversification of crop production, playing a positive role in promoting coarse grain cultivation.

## 4 Effects of the introduction and improvement of food crops in Taiwan during the Japanese colonial period

### 4.1 The effects of rice improvement and the colonial orientation of rice consumption

During the Japanese colonial period, significant progress was made in the improvement of rice cultivation in Taiwan. According to historical sources such as *Taiwan Grain Statistics Overview (Taiwan liangshi tongji yaolan)*, both the cultivated area and total output of rice increased substantially. In 1900, the rice cultivation area in Taiwan was approximately 326,000 hectares, yielding 307,000 metric tons, with an average output of about 943 kilograms per hectare. By 1920, the cultivated area had expanded to 500,000 hectares, and production had risen to 692,000 metric tons, averaging roughly 1,383 kilograms per hectare. By 1944, the rice cultivation area reached 601,000 hectares, with a total output of 1,068,000 metric tons and an average yield of approximately 1,778 kilograms per hectare (Government-General of Taiwan, 2014). Based on the above data, the author has prepared Figure 6.

According to the above data, the cultivated area of rice in Taiwan expanded from 326,000 hectares in 1900 to 601,000 hectares in 1944—nearly a twofold increase. During the same period, total rice production rose from 307,000 metric tons to 1,068,000 metric tons, representing more than a twofold increase. In addition, the average yield per hectare improved significantly, increasing from 943 kilograms in 1900 to 1,778 kilograms in 1944—almost doubling over four decades. Rice yields increased across all regions, with the Taipei area showing steady annual growth between 1910 and 1917,

further demonstrating the effectiveness of the improvement programs.

By the 1920s, Taiwanese rice varieties had gradually replaced traditional foreign strains, leading to enhanced productivity and adaptability. At the same time, the combined output of wet-field and upland rice rose markedly: by 1941, the cultivated area of rice had nearly doubled compared to 1899, while total production had quadrupled. Overall, through varietal introduction, advances in cultivation techniques, and the broader process of agricultural modernization, rice production and scale in colonial Taiwan expanded continuously during the Japanese period.

However, from the perspective of the colonial economic structure, the so-called “abundant harvests” of rice did not benefit Taiwanese society itself. Beginning in the 1920s, the Japanese government purchased large quantities of rice from Taiwan for export to the Japanese mainland, and by around 1937, exports to Japan accounted for approximately 50% of Taiwan’s total rice production. In other words, the expansion of Taiwan’s agricultural output primarily served the metropole’s food strategy rather than the improvement of local livelihoods. The technological “modernization” of agriculture, in effect, reinforced Taiwan’s economic dependence on Japan and revealed the structural imbalance inherent in the colonial agricultural system.

The Japanese efforts to improve rice production in Taiwan were not intended to enhance the living standards of the Taiwanese population. A substantial portion of the high-quality rice produced in Taiwan was either requisitioned by the Government-General of Taiwan as military provisions to support Japan’s external wars of aggression or exported to the Japanese mainland for consumption by Japanese citizens. To provide a clear visual representation of Japan’s exploitation of Taiwan’s grain resources, the author has prepared

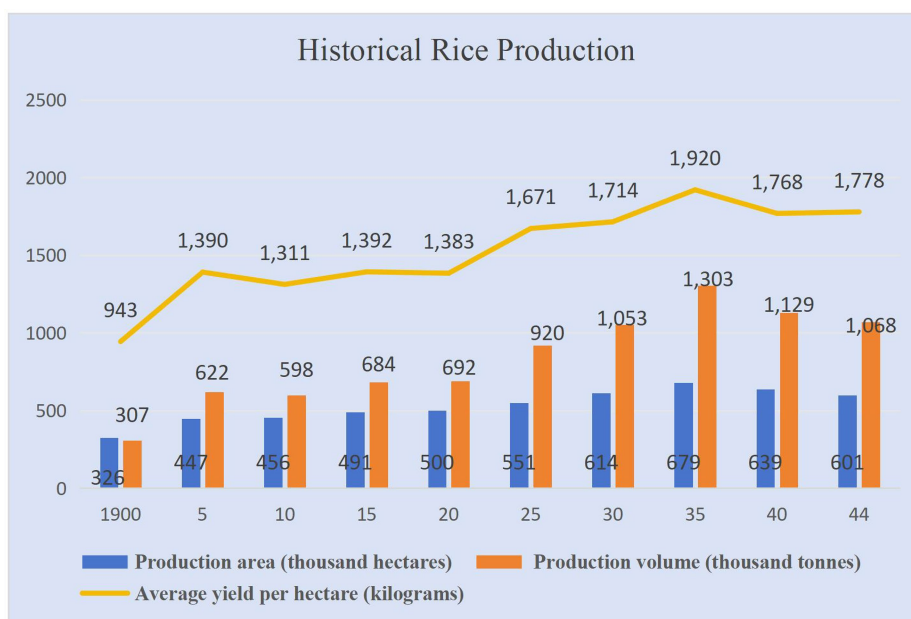


FIGURE 6 Changes in cultivated area, production volume, and average yield per hectare of rice in Taiwan during the Japanese colonial period. Taiwan Provincial Food Bureau. *Taiwan grain statistical overview [Taiwan liangshi tongji yaolan]*, 1949. Reprinted from Chou (1980, p. 488).

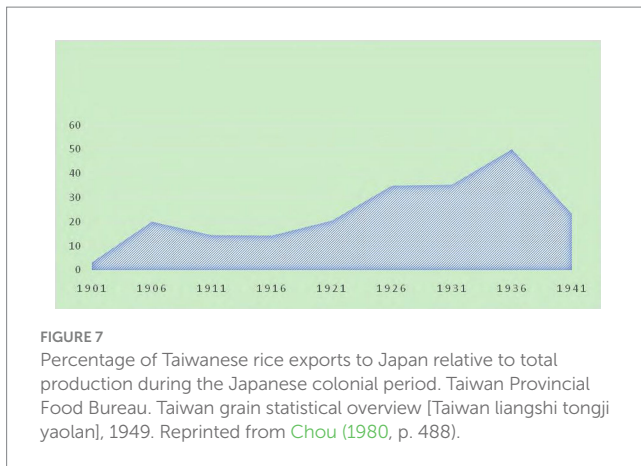


Figure 7, illustrating the percentage of Taiwan's rice exports to Japan relative to total production during various years of the colonial period.

As shown in Figure 7, the proportion of rice produced in Taiwan that was exported to Japan during the Japanese colonial period was remarkably high. Between 1916 and 1921, approximately 20% of Taiwan's total rice production was shipped to Japan, and this proportion continued to rise thereafter. By around 1937, roughly 50% of all rice produced in Taiwan was exported to the Japanese mainland. After 1937, the volume of exports declined somewhat due to the impact of Japan's war of aggression against China. Thus, although both the yield and quality of rice in Taiwan improved during the colonial period, these developments primarily served Japanese interests rather than benefiting the local population. Taiwanese farmers, who labored intensively in rice cultivation, were often unable to consume the rice they produced and were instead compelled to subsist on sweet potatoes and other coarse grains.

## 4.2 The failure of wheat improvement and the success of sweet potato improvement

In contrast to rice, the improvement measures for wheat cultivation in Taiwan during the Japanese colonial period failed to significantly increase its cultivated area or yield. Although the Government-General of Taiwan implemented initiatives such as the introduction of disease-resistant wheat varieties, the promotion of triple-cropping systems combining rice and wheat, and crop rotation practices, the overall results were limited. The primary causes included the effects of natural disasters and widespread plant diseases—particularly rust and powdery mildew—which were especially severe in humid regions. Moreover, Taiwan's climatic and soil conditions were not well suited for wheat cultivation; poor drainage and high soil acidity further constrained growth. Additional factors, such as weak market demand, competition for arable land from the expanding sugar industry, and low wheat prices, reduced farmers' incentive to cultivate the crop. Overall, despite the introduction of improvement measures, multiple environmental and economic constraints prevented effective increases in wheat cultivation area and yield, and in some cases even led to a decline.

Unlike wheat, the improvement of sweet potato cultivation in Taiwan during the Japanese colonial period achieved remarkable

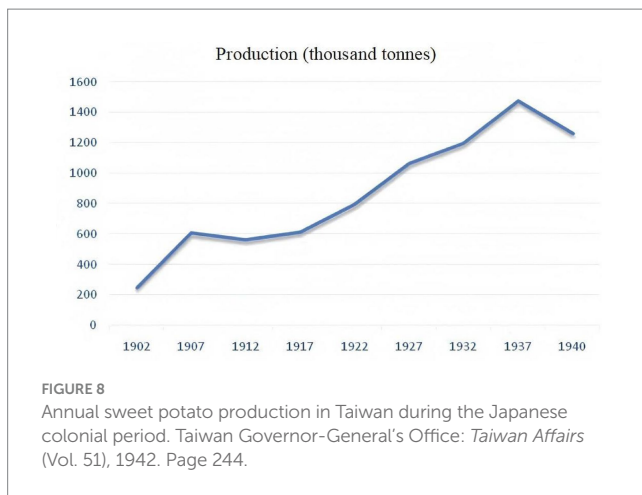
success, with both the cultivated area and total output increasing substantially. According to data from the *Taiwan Grain Statistics Overview*, in 1900 the cultivated area of sweet potatoes was 19,855 hectares, yielding 205,966 metric tons. By 1945, the cultivated area had expanded to 134,715 hectares, and total production reached 1,165,263 metric tons—6.78 and 5.66 times higher, respectively, than in 1900. This demonstrates that sweet potato cultivation in Taiwan experienced significant growth during the colonial period, both in terms of acreage and yield.

Furthermore, sweet potatoes occupied a prominent position among Taiwan's starch-producing crops, ranking first in both cultivated area and total output, and became one of the island's principal staple foods. Although this expansion reflected certain advancements in agricultural science and technology, its deeper cause lay in the structural food substitution within colonial Taiwanese society: as high-quality rice was increasingly exported to Japan, sweet potatoes became the primary staple food for the local population. In other words, the "abundance" of sweet potatoes symbolized not an improvement in living standards but a form of *forced adaptation* under colonial rule. Based on production data recorded in *Taiwan Affairs (Taiwan shiqing)*, the author has prepared a chart illustrating the annual output of sweet potatoes.

As shown in Figure 8, Taiwan's annual sweet potato production increased steadily beginning in 1902. By 1907, annual output had already tripled compared with that of 1902. After 1917, sweet potato production rose sharply once again and continued to grow until 1937. By that year, Taiwan's annual harvest of sweet potatoes was more than seven times that of 1901.

What accounts for this remarkable surge in sweet potato production during the Japanese colonial period? The primary reason lies in the colonial food structure: the high-quality rice produced in Taiwan was largely consumed by Japanese residents or exported to Japan, leaving local Taiwanese with limited access to it. To sustain themselves, they were compelled to cultivate sweet potatoes extensively as their principal source of food. This phenomenon vividly illustrates the colonial nature of Taiwan under Japanese rule—where the island functioned merely as Japan's grain production base and as a strategic springboard for its southward expansion and military aggression. Under such a colonial regime, the Taiwanese people were denied the prospect of a decent standard of living.

In summary, the 50 years of Japanese colonial rule in Taiwan witnessed the extensive promotion of *Penglai rice* and the systematic improvement of rice varieties. However, these efforts were primarily driven by Japan's preference for rice that suited domestic taste rather than by any intention to enhance Taiwan's agricultural welfare. While rice production and quality improved, and the industry appeared to modernize, its development was fundamentally distorted by the island's colonial status. Japan's so-called "agricultural modernization" served the interests of the metropole, not the colony. Moreover, the large-scale cultivation of *Penglai rice* to cater to Japanese consumption led to excessive monoculture and structural imbalance within Taiwan's agricultural sector. When Japan withdrew from Taiwan and its colonial system collapsed, this overly dependent and single-crop production structure proved unsustainable. The postwar disarray of Taiwan's agricultural economy thus stands as a typical example of the inherent "unsustainability" of colonial modernization.



### 4.3 Sorghum

During the Japanese colonial period, improvements in sorghum cultivation in Taiwan were primarily reflected in the expansion of cultivated area and the increase in yield. By 1944, both the cultivation area and total production of sorghum had reached their peak. Cultivation was especially prevalent in the Penghu Islands. According to historical records, in 1925, Penghu's sorghum cultivation area covered 3,871 *jia* (approximately 56,323 *mu*), with a total output of 13,993 thousand *jin* and a total production value of 199,031 yen, yielding 3.6 *jin* per *jia*. By 1928, although the cultivation area had slightly declined, the yield per *jia* increased to 3.86 *jin*. Despite periodic fluctuations in the area under cultivation, both total output and per-unit yield of sorghum in Penghu showed a gradual upward trend, indicating improvements in cultivation efficiency. However, sorghum production continued to face serious challenges from major diseases such as *Sphacelotheca sorghi* (sorghum smut) and downy mildew, as well as infestations of pests such as the barley moth (*Sitotroga cerealella*).

## 5 Conclusion

### 5.1 Research summary

During the Japanese colonial period, the colonial administration actively promoted the introduction and improvement of food crops in Taiwan, thereby driving a systematic transformation in agricultural production. Through the introduction of foreign varieties, the construction of irrigation systems, and the establishment of agricultural experiment stations and technology-extension frameworks, both the productivity and composition of Taiwan's crop sector underwent profound changes. The output of staple crops such as rice, sweet potatoes, and sorghum increased significantly, forming a production system centered on high-yield paddy cultivation and hardy coarse grains. Between 1900 and 1944, the cultivated area of rice expanded from 326,000 hectares to 601,000 hectares, while total production rose from 307,000 metric tons to 1,068,000 metric tons, demonstrating a marked upward trend. Sweet potato cultivation experienced even more rapid growth: by 1945, its planted area and output had reached 6.78 times and 5.66 times those of 1900,

respectively, making it a principal staple and compensatory crop in rural Taiwan. By contrast, the improvement of wheat failed to achieve the intended results; constrained by Taiwan's hot and humid climate, acidic soils, and limited market demand, its cultivated area even declined over time.

From the perspective of institutional arrangements and market structures, the successful improvement of rice and sweet potatoes stemmed from production logics that aligned with the demands of the colonial economy: rice exports fulfilled Japan's domestic needs, while sweet potatoes served as a basic subsistence food for the colonial labor force. In contrast, the failure of wheat improvement reflected a disjunction between policy objectives, environmental constraints, and market conditions. This suggests that the effectiveness of colonial agricultural policies depended on their compatibility with local production systems rather than on technological advancement alone. The colonial slogan "Industrial Japan, Agricultural Taiwan" (*kōgyō Nihon, nōgyō Taiwan*) epitomized this economic strategy. While these policies facilitated certain aspects of agricultural modernization, they also intensified resource inequality and reinforced social stratification. Consequently, once broader structural conditions shifted, the livelihoods of the Taiwanese population were acutely affected, and adaptation to these changes often required several years of adjustment.

### 5.2 Long-term impact

From a long-term perspective, the crop improvement policies implemented in Taiwan during the Japanese colonial period simultaneously advanced agricultural technologies and reinforced the island's structural economic dependence. On the one hand, the colonial administration laid the technological and institutional foundations for the sustained development of modern agriculture through experimental research, extension systems, and the construction of agricultural infrastructure. On the other hand, this development was not oriented toward the overall welfare of Taiwanese society, but rather centered on Japan's food-security strategy. The improvement and increased productivity of rice primarily served the needs of the Japanese mainland, with exports during the 1930s at times exceeding half of total production. Correspondingly, sweet potatoes and coarse grains accounted for an increasingly large share of Taiwanese farmers' diets, and living standards did not improve in tandem with technological progress. This structure of "export prosperity amid domestic deprivation" reveals the intrinsic asymmetry of agricultural growth in Taiwan under Japanese colonial rule.

From a social perspective, although the agricultural modernization policies implemented by the Japanese colonial government enhanced overall productivity in Taiwan, they simultaneously exacerbated land consolidation and social stratification. The Land Survey Project carried out between 1898 and 1905 led to a concentration of land ownership, as Japanese capital and local landlords seized the opportunity to purchase large tracts of farmland, resulting in the gradual disintegration of the traditional smallholder class (Wu, 2017). Capital-intensive paddy farming and the landlord-tenancy system were further strengthened, while tenant farmers faced increasing rental burdens. Studies have shown that land rents in colonial Taiwan remained persistently high, and tenancy relations were characterized by severe inequality (Yeh, 2001).

Meanwhile, the structural orientation of the colonial economy—marked by the expansion of the sugar industry and the export-driven rice sector—rendered agricultural incomes highly dependent on the Japanese market. Although sweet potatoes and coarse grains helped maintain a degree of rural food security, they also became symbolic of the subsistence patterns of marginalized social groups (Chiu, 1931). In the sugar industry, sugarcane farmers were systematically constrained by contractual arrangements and pricing mechanisms imposed by sugar companies and colonial authorities, resulting in highly unequal distributions of income (Lin, 2019).

This phenomenon of “technological advancement accompanied by social stratification” illustrates what colonial political economy identifies as the logic of *developmental exploitation*—a form of modernization driven by external power structures and characterized by structural inequality, rather than autonomous development.

During the Japanese colonial period, the development of food crops in Taiwan exhibited a characteristic pattern of “colonial structural imbalance,” in which overall agricultural direction was entirely subordinated to the economic strategies and food-allocation regime of the Japanese Empire. Guided by the principle of “colonization through agriculture,” the colonial government systematically reorganized Taiwan’s cropping structure to serve the industrialization and wartime demands of the Japanese mainland.

Among the major food crops, rice was designated as the central crop of colonial agriculture. Through large-scale irrigation projects, varietal improvement, and technical extension programs, rice production increased substantially; according to the *Taiwan Food Statistics Compendium*, by the 1940s rice output had grown to more than three times its level in the 1890s. However, this expansion primarily served Japan’s import needs, as large quantities of high-quality rice were shipped to the mainland, leaving the local population increasingly reliant on sweet potatoes for subsistence. Within the colonial economic system, sweet potatoes functioned as an “internal stabilizer”: their high yield and tolerance of poor soils made them the primary staple for the laboring population, but this also reflected the growing monocultural and “low-end” orientation of Taiwan’s agricultural structure.

By contrast, crops such as wheat, coarse grains, and legumes were long neglected because they did not align with Japanese dietary preferences or economic interests. Although the Governor-General’s Office attempted to promote wheat cultivation to improve crop rotation systems, these efforts yielded limited results due to climatic constraints and insufficient market demand. Such policy-driven biases produced a profoundly unbalanced agricultural structure: high-value crops were concentrated within the export-oriented sector, while low-return crops supported local subsistence—forming the quintessential “dual agricultural structure” characteristic of colonial economies.

Overall, the improvement and development of food crops in Taiwan achieved technological modernization, yet simultaneously reinforced colonial dependency and resource inequality at the structural level. The gains of agricultural modernization did not translate into enhanced welfare for farmers; instead, they became subordinate to Japan’s economic expansion. This reveals the institutional contradiction inherent in colonial modernization, wherein economic “growth” coexisted with systematic “deprivation.”

## 5.3 Conclusion

Following China’s defeat in the First Sino-Japanese War, Japan seized Taiwan through the Treaty of Shimonoseki and ruled the island as a colony for 50 years until its retrocession in 1945. This half-century constitutes a distinct period in Taiwan’s history. In global context, these five decades encompassed two world wars in which Japan was a belligerent. Consequently, as a Japanese colony, Taiwan’s economy suffered not only from Japan’s extractive colonial policies but also from the broader impacts of wartime mobilization. As Japan’s staple grain, rice was inevitably integrated into the Japanese wartime apparatus. Rice production in colonial Taiwan thus bore the unmistakable characteristics of a colonial economy and followed a highly distorted developmental trajectory.

Prior to Japanese occupation, Taiwan’s rice cultivation relied on relatively rudimentary techniques and underdeveloped infrastructure; yet domestic production was sufficient to sustain the island’s population. After taking control, Japan—seeking to support its external military expansion—undertook comprehensive improvements to Taiwanese rice in order to procure larger quantities of rice varieties better suited to Japanese consumption preferences. Under the initiatives of the Government-General of Taiwan, rice production volume, cultivation area, and the degree of technological and managerial modernization increased substantially compared with the early colonial years.

However, the fundamental objective of these reforms was not to enhance the welfare of the Taiwanese population, but to secure a stable supply of high-quality rice for the Japanese mainland. In effect, the colonial administration reconfigured Taiwan into a grain-producing base embedded within Japan’s broader system of imperial expansion and wartime logistics, rather than fostering the island’s autonomous agricultural development. Taiwanese farmers were compelled to contribute more labor than before the Japanese occupation, yet they remained largely excluded from the benefits generated by improvements in rice production and were forced to rely on sweet potatoes and other coarse grains to maintain subsistence.

After Japan’s defeat and Taiwan’s retrocession, this agricultural structure—long dependent on monocultural export and external demand—collapsed rapidly. The resulting structural imbalances and production disorder required several years to stabilize, and the ultimate burden of adjustment fell on the island’s ordinary inhabitants.

## 5.4 Future research directions

From a theoretical perspective, the experience of crop improvement in Taiwan during the Japanese colonial period illustrates the “paradox of colonial modernization.” Technological innovation and institutional development did contribute to the modernization of agriculture; however, their fundamental purpose was to serve the economic demands of Japan’s militarist center rather than to promote autonomous development within colonial Taiwan. Although agricultural productivity increased substantially, these advances deepened the island’s structural dependence on the metropolitan market. Moreover, the modernization of institutions and technology did not lead to greater social equity; instead, it entrenched the unequal patterns of resource allocation characteristic of colonial rule.

Future research may adopt a comparative perspective to examine the commonalities and divergences in agricultural technology transfer and institutional construction across other East Asian colonies, such as Korea,

the Philippines, and Indonesia, thereby illuminating the structural patterns underlying “colonial agricultural modernization” within imperial systems. In addition, quantitative methods and GIS-based spatial data can be employed to verify the interactive mechanisms linking policy orientations, environmental conditions, and social outcomes. Such analyses would not only deepen our understanding of the origins of agricultural modernization in Taiwan, but also offer historical insights for contemporary developing countries seeking sustainable agricultural development under conditions of external dependency.

## Data availability statement

The datasets presented in this article are not readily available because there are no restrictions on the dataset; all data are publicly available and can be accessed freely. Requests to access the datasets should be directed to the dataset used in this study is derived from the Statistical Reports of the Government-General of Taiwan (Taiwan Sotokufu Tōkei), published during the Japanese colonial period (1895–1945). These historical data are publicly available in the archives of the National Taiwan Library and the Academia Sinica digital database. Requests for access or further information can be directed to the corresponding author at [nie\\_hao\\_ran@126.com](mailto:nie_hao_ran@126.com).

## Author contributions

HN: Writing– original draft, Conceptualization, Data curation, Formal analysis, Investigation. AL: Writing– review & editing. HC: Writing– review & editing.

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