



In the morning



At midday



In the evening



In moon light

Thai Rice

A crop that shapes the lives and land of a people,
feeds the world, and has in turn been moulded by them

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Introduction

Thai rice feeds people in more than 160 countries. Another 20 million visitors from all corners of the globe travel to Thailand every year, getting to taste Thai rice, many for the very first time. For the people of Thailand and their ethnic kin throughout Asia, the word *Kao* (rice) is synonymous with food, and *Kin Kao* translates to 'eat a meal'. This book introduces the many faceted story of Thai rice to its new and longtime fans – for those students of rice, in and outside school and university, wishing to increase their knowledge of rice, as has been described and explained by science. Attempts have been made to integrate basic understanding of rice science into the world of rice growers, traders and eaters, including the work on the local rice germplasm and its ecological and socio-economic context of students, researchers and academics at Chiang Mai University, which has contributed to the establishment of the Lanna Rice Research Centre.

The book begins by describing the place of rice in Thailand's geographical and historical landscape (Chapter 1). This is followed by an historical account to illustrate the evolution of rice farming since the reign of Rama IV (1851-1868), and to provide a sketch of the rice farms on which the country's first babyboomers grew up (Chapter 2). Rice is generally grown as a wetland crop, on soil flooded under a few centimeters of water, but it can also be grown as 'upland rice' on well-drained soil. On soil that could not be levelled and flooded, in the undulating uplands and on mountain slopes, upland rice was once an important supplement to the country's subsistence rice production. Upland rice has, however, been disappearing with commercialization of Thailand's agriculture (Chapter 3). Diversity of Thai rice, beyond the many different forms perceived by the eaters, is next described (Chapter 4). The many different appearances and tastes that confront eaters of Thai rice are then introduced (Chapter 5). Along with other rice growing countries of Asia, Thailand has greatly benefitted from modern rice technology, but the green revolution was applied somewhat differently from that in other rice growing countries (Chapter 6). The ways in which government intervention has helped and hampered rice farming, processing and trade are highlighted (Chapter 7). The book concludes with a look at future challenges and opportunities facing Thai rice (Chapter 8).

Major sources of data and references are provided at the end of the book, together with glossaries of a list of plants and animals with their scientific name and Anglicized Thai terms and names.

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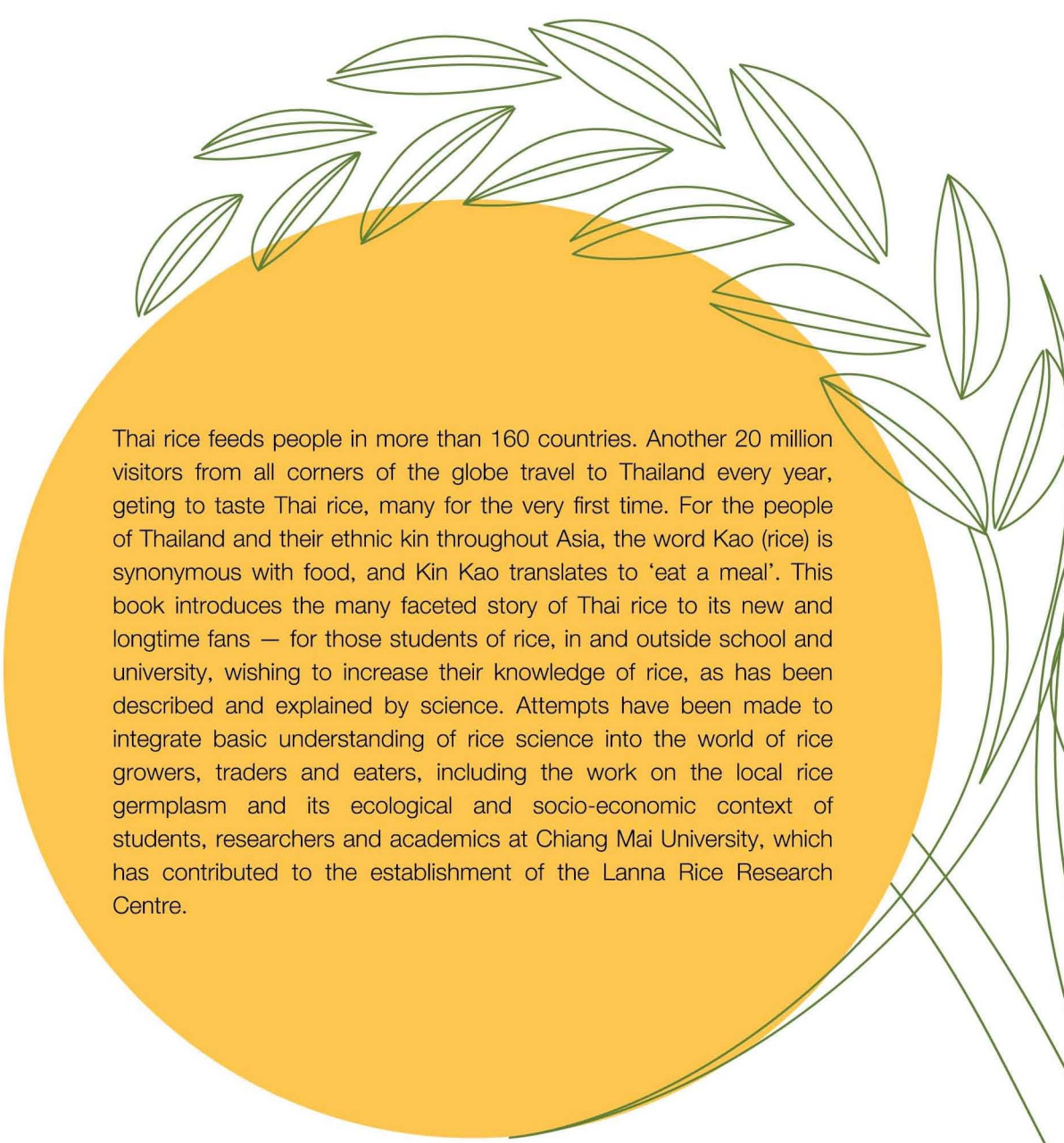
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Chapter

THAI RICE LANDSCAPE

Thai people, along with their ethnic kin across mainland Southeast Asia, northeast India and southwestern China, are people of the rivers and flood plains. Traditional Dai, Tai or Thai villages are often made up of houses and the ubiquitous Buddhist temple grouped together on the high grounds of the river levees, with an expanse of rice fields stretching out into the flood plain. Since time immemorial, beginning with conversion of tall grass swamps to grow rice, the landscape has been shaped to meet the needs of the rice plant and rice eaters. Although it is sometimes grown on soil drained of excess water on mountain slopes and undulating land, most rice is grown on soil submerged under a few to several centimetres of water. Rice (*Oryza sativa* L.) now covers more of the land area in Thailand than any other single plant species. Developing land to grow rice involves soil surface levelling and construction of low earthen embankments, or bunds, to impound water in fields cultivated by individual households, but also frequently requires communal organization to control, manage and distribute the water supply.

Until relatively recently, the rice growing season in most of the country was dictated by the southwest monsoon bringing rain from the Indian Ocean from May to September. Local rice varieties have evolved to adapt to the rainfall pattern, by flowering when the rain begins to taper off and ripening after the rain has ended. During the long dry months, the rice fields were once parched and lifeless, except for buffaloes grazing the rice stubble and their attendant myna birds. In many areas of the country, the scene changed in the 1970s with the arrival of a new type of rice plant that was productive year round and the availability of irrigation water in the dry season by public investment in major irrigation schemes. Irrigated off-season rice (*Na Prang*), which follows the harvest of the main wet season crop (*Na Pee*) in November to December, now keeps a quarter of the country's rice land lush and productive through much of the dry season. In some areas the rice crop is planted continuously, with total disregard for the season, achieving 2.5 to 3 crops annually. Rice has continued to play a crucial role in Thailand's social and economic development, shaping its historical as well as geographical landscape.



In the wild

Wild rice (*Oryza rufipogon* L., not to be confused with the American wild rice *Zizania aquatica* L.), the closest wild relative of rice believed to be the ancestral species of cultivated rice, is basically a water plant. Readily distinguished at flowering by the awn, a fine needle like structure one to several centimetres long at the tip of the floret that may be in any shade of pink to red as well as white, wild rice is found throughout Thailand (and Cambodia, Laos and Myanmar) in wild wet places, or in close association with cultivated rice fields, as perennial or annual types depending on seasonality of the water. The perennial type is a common part of the shoreline vegetation of lakes and other permanent water bodies, including unlined irrigation canals. The annual type, with its life cycle closely following the monsoons, is found in seasonal wet places where rain water collects, disappearing as these dry out. In depressions in the landscape, along irrigation and farm ditches, on the edge of rice fields, abandoned water buffaloes' mud-holes and roadside verges, the annual wild rice flower and set seed at the end of the annual monsoons and then die as the dry season sets in, to be revived as the seed germinates with the opening rains of the next monsoon season.



1.1 Wild rice, a close relative believed to be the ancestral species of cultivated rice, is a common sight in many parts of Thailand, from September to October

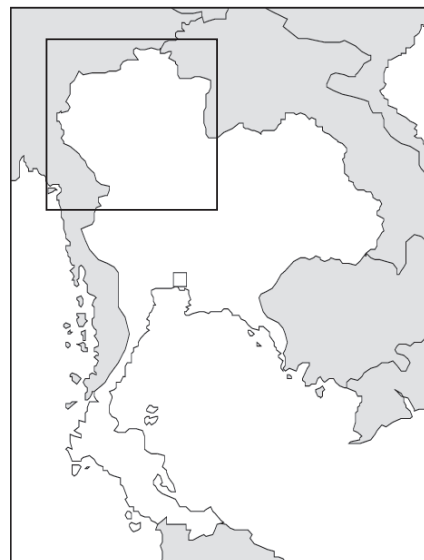
Source: Songkran Chitrakorn



Kingdom of Rice

Thailand's modern history started with the consolidation of three neighbouring kingdoms at the turn of the 13th century: 1) Lanna, around present-day Chiang Mai, 2) Sukhothai, 300 kilometres to the south where the mountains open out into the Plain of the Chao Phraya, Thailand's premier river system, and 3) Phukamyao, in the vicinity of present-day Payao, some 200 kilometres northeast of Chiang Mai. Commemorated by a bronze statue in the centre of Chiang Mai, the alliance of the three kings is generally believed in Thailand to be a manoeuvre preparing to counter the threat from the military might of the first Yuan Emperor of China (aka Kublai Khan), which fortunately was defeated by deadly tropical fever before it could reach so far south. There were other rice-based kingdoms and principalities in the region, some of which went back hundreds of years. A clue to the Tai heritage may be found in their old names, especially the prefix "Chiang", as in Chiang Mai and Chiang Rai, believed by some to mean walled city or town. There was Chiang Thong (Xiang Thong) at present-day Luang Prabang in the People's Democratic Republic of Lao, and Chiang Tung at the town of Keng Tung in Myanmar's Shan State. Further north, in China's southwestern prefecture of Xishuangbanna in Yunnan province, a contemporary of Lanna called Sibsong Banna (twelve rice districts in Dai/Tai/Thai), had its seat of power at Chiang Hoong (present-day Jinghong) on the bank of the Lancang Jiang (Mekong River). Inscriptions on stone tablets testify to the importance of well-organized irrigation schemes that greatly enhanced productivity of the rice land in many of these kingdoms.

1.2 An alliance of three rice-based Tai kingdoms at the close of the 13th century is commemorated in the heart of Chiang Mai with statues of the kings: Mengrai, Ramkamhaeng and Ngam Muang



Development of rice fields and irrigation systems in this region well-endowed with water had, in fact, been going on earlier; and was still taking place until the 1950s, when new land could still be claimed. A group of farmers from one to a few villages, invariably led by a strong, visionary leader, would band together to construct, maintain and manage *muang-fai* (*fai* = barrage or weir, barrier across stream to raise water level; *muang* = irrigation channels), including distributing and sharing water to grow rice. Before their replacement by concrete structures towards the end of the 20th century, the weirs were made with bamboo, wooden stakes and rocks. Rice growers contributed labour and materials, according to the size of the rice land they farmed for the annual maintenance of the weir and cleaning up common irrigation ditches. Materials from some old weirs near Chiang Mai were carbon dated to be more than 1,200 years old.



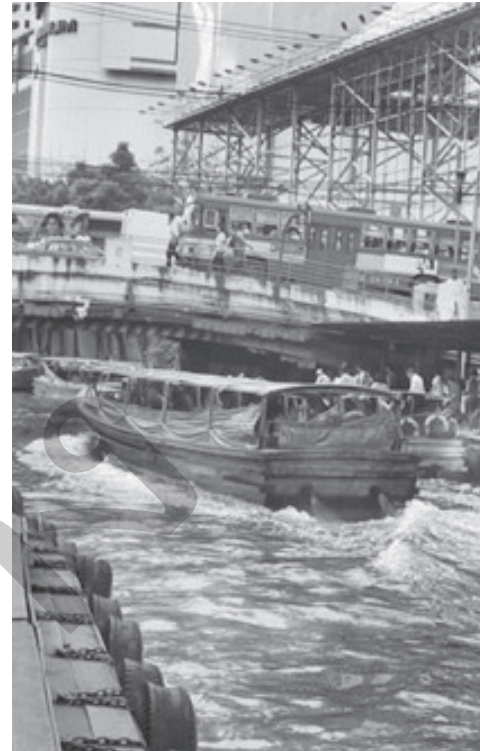
1.3 Community collaborative maintenance of the barrage (fai) of a traditional irrigation system in northern Thailand



1.4 Chiang Mai Old City plan (upper right); a section of the wall and moat (upper left); a satellite image of the city bounded on four sides by the moat (lower)

Chiang Mai old city, an area of $1.6 \times 1.7 \text{ km}^2$, with the complete moat and some of the surrounding brick wall still standing today, was built by King Mengrai (1238 – 1317) on the western edge of the Ping River valley, and named *Nopburi Sri Nakorn Ping Chiang Mai*. Before being encroached upon by the urban sprawl of modern Chiang Mai, the valley had been transformed into a million *rai* (160,000 ha) of well-watered rice land. Development and management of the irrigation systems were local, communal affairs, but with the power of management boosted by the law of the land since the early days of Lanna. Those responsible for the organization and management of the irrigation system, such as *Kae Muang* (the irrigation leader) and *liab nam* (water inspectors), were appointed and paid locally by communal consent, but their authority was recognized by law. The

Mangrai Sart, as Mengrai's laws were known, stipulated in detail how, "He who has not contributed to the building and upkeep of the *muang-fai* but caught stealing water is to be clouted on the head and let go, or fined 110 silver pieces. If he does it again, it will not be murder to take his life at the scene of theft". In an altercation over irrigation, a thief who happened to kill a *liab nam* would face a stiff fine, but it was not a crime for the *liab nam* to take the life of someone in the act of stealing water. Different levels of fines and punishments were elaborated, for example, for damages done to the system, whether maliciously/intentionally to steal water, or unintentionally, such as damages caused during fishing activities.



As the Sukhothai Kingdom came to a close towards the end of the 1400s, the centre of power shifted to Ayutthaya, further down into the main Chao Phraya Plain. The command over this 55,000 km² of well-watered and fertile alluvial plain, which is bigger than Denmark, brought enormous wealth to the court from rice production, contributing to the golden splendour that so impressed Louis XIV's ambassador, Chevalier de Chaumont (1640 - 1710). Rice export was flourishing, with the king's own trading fleet, as well as Dutch, French and other foreign traders, supplying European colonies from Indochina and Java to Malaya and the Philippines. By the early eighteenth century the Chinese, in their "junks" (sailing ships), became the dominant force in the Thai rice export trade. *Siam Lo or Siam Lo Kok*, as Thailand was then known in China, featured in Chinese historical trade records as the source of plentiful and cheap rice. Taxes were levied on the rice export trade and farmers, who were required to deliver part of their harvest to the royal granaries. Relocation of the capital to Thonburi, and then Bangkok, at the mouth of the Chao Phraya Delta, following the 1767 devastation of Ayutthaya by the Burmese, led to the opening up of the lower Chao Phraya Plain. This completed the conversion of the entire river basin into one of the world's most productive rice regions, and rice export received a boost with access to larger ocean going vessels at the port of Bangkok.



1.5 Khlong Saen Saep Express Boat: Pratunam Pier, Bangkok

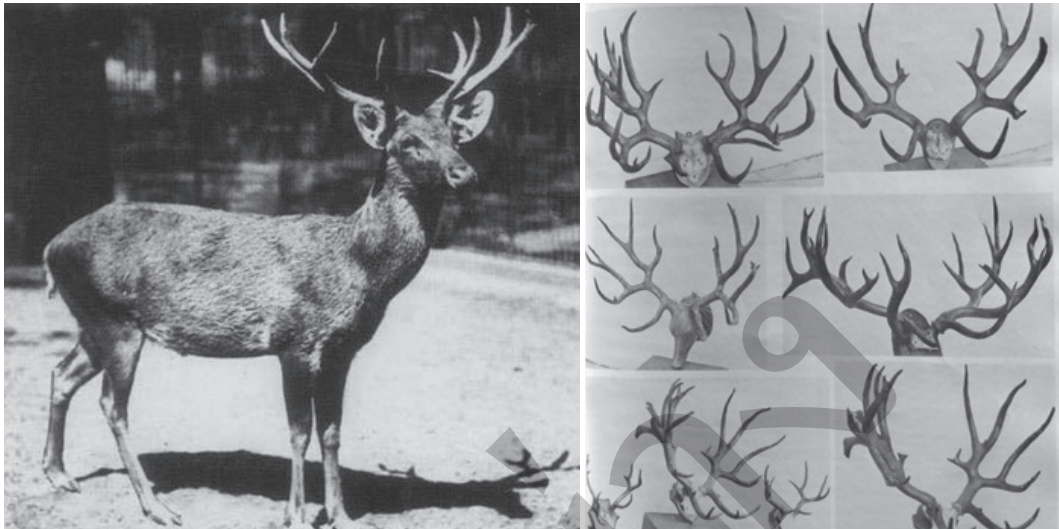
Source: Heinrich Damm

Conversion of *Toong Luang*

Toong Luang (Royal Grassland), from present day suburban Bangkok to the north, was once a vast savannah of tall grasses, populated by snakes (“larger than a man’s upper arm”), crocodiles, wild pigs, tigers, many different kinds of deer and numerous other wildlife. Roaming herds of elephants created their own moving ecosystem, as the vegetation they pulled down and trampled fed the following flocks of smaller herbivores that in their turn became prey to the attending carnivores; with the scavengers close behind. Large expanses of the grassland turned into wetlands for half of the year or more. Into the dry season, the receding floods left behind water holes that were teeming with fish, while open water bodies received flocks of wild ducks, waders and other migratory birds escaping from the harsh winter in the high latitudes.

Settlement and conversion of most of the Chao Phraya Delta for rice cultivation followed construction of canals linking the main rivers, often for military rather than agricultural or developmental purposes. For example, Saen Saep canal, completed in 1840 to connect the Chao Phraya River and Bang Pakong River to the east, was built by Rama III (1788 - 1851) to aid his war efforts with Annam (pre-1945 name for Vietnam) over Cambodia. An express boat service on an 18 km section of the original 72 km canal now provides one of the fastest ways to travel across the heart of present-day Bangkok.

Stimulated by the booming rice trade in the second half of the 19th century, a consortium of noblemen, local businessmen with court connections and fortune hunting Europeans was granted permission from King Rama V (1853-1910) to develop *Toong Luang*. Completed at the turn of the 19th century and named by the King, the Rangsit Canal, together with smaller lateral canals, connected the region to the Chao Phraya River, the country's primary transport artery of the time, the smaller Nakhon Nayok River to the east, and Bangkok. This network of waterways brought settlers to the once wild region, including many freed slaves following abolition of slavery in 1905. Rice traders' boats plied the area following the rice harvest, and strings of laden barges brought rough rice to mills that lined the banks of the Chao Phraya, and milled rice to be loaded onto exporters' ships, as well as to feed rapidly growing urban Bangkok. By the early 1920s, Thailand was exporting more than one million tons of milled rice each year. Unfortunately, this conversion of Toong Luang had an inevitable disastrous impact on wildlife, as their habitats were taken over by rice fields. The last wild population of *Nua Samun* (*Rucervus schomburgki*, Schomburgk's deer), a graceful native of the open and swampy grassland with beautiful antlers, was hunted out in the 1930s, as they congregated in isolated islands to escape the annual floods. Captive breeding might have saved the species had the 1905 effort to secure mates for the lone male in the Berlin Zoo not been frustrated by an ill-fated error in translation that sent the expedition to Korat in the northeast, more than 200 kilometres from the animal's habitat. The Schomburgk's deer is now listed as extinct by the International Union for Conservation of Nature.



1.6 Nua Samun [Schomburgk's deer] at the Berlin Zoo, 1911 (left) and their antlers (right)

Source: Lekagul/McNeely 1977 for the antlers

Rice in difficult environments

Developing land to grow rice as a wetland crop, i.e., on soil flooded under some centimetres of water, is a major undertaking, requiring considerable investment of capital, labour and time. Those with insufficient access to such resources in the past, and people now living in the mountains where flat land is scarce, grew “upland rice”, without the impounded water. Not in any sense associated with elevation of the land, the term “upland” here simply means rice grown on well aerated, non-flooded soil, to distinguish it from the “wetland rice” that grows on waterlogged, flooded soil. Upland rice, now grown mainly in the mountains, once occupied a sizeable proportion of Thailand's rice landscape. New settlers with limited resources in river valleys, including the Chao Phraya Plain, employed the “slash and burn” method of cultivation to grow rice to feed themselves before the heavy investment required to develop wetland fields became affordable. Upland rice also provided a means for poorer farmers, with limited means and lacking the prime land for growing wetland rice, to feed their family. Since the 1960s, crop production in Thailand has greatly diversified, from primarily rice, to now include many other crops. In those areas not subjected to annual flooding, the subsistence upland rice crop has largely been replaced by cash crops, such as maize, cassava, green gram, black gram, soybean, and sugarcane.



1.7 Deep water rice researcher (upper); Pin Gaew 56, a six metre tall floating rice variety (lower)

Source: Rice Department

In low-lying areas, no other crop but rice can survive the flood from the accumulating monsoons, topped up with runoff from almost the entire northern watershed. This remains true even where tractors, chemical fertilizer and pesticides have now replaced the slash and burn method of cultivation. Like most living organisms, the rice plant needs oxygen. The roots are able to grow and function in oxygen-depleted, flooded soil, only because air is sent down from the top via special passages called the aerenchyma. So while the rice plant is well adapted to have its roots in water, it drowns when completely submerged for only a few days. Local farmers have selected rice varieties specially adapted to different flood regimes that vary in depth and duration of the flood and also how rapidly it rises and falls. The rice grown here is required to be adapted to water depths from one-half to six metres, depending on position of the field on the flood plain. In two neighbouring fields that drain just a week apart, a farmer may need to grow two different rice varieties. Rice that can rapidly extend its stem to keep its head above the rising flood is called *Kao Kuen Nam* (floating rice). The trigger for this rapid stem extension is a gas called ethylene (C_2H_4 , same gas that ripens fruits), which the rice plant is stimulated to produce when submerged. Unlike free-floating plants, such as water hyacinth or water kangkong, the roots of floating rice are still firmly anchored to the soil. At harvest, the rice panicles may be some meters away from the roots. Where the flood has not yet drained away, harvest is done by boat.