CHAPTER 1

The Evolution of Rice Farming in the Lower Mekong Basin

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In their definitive review of the Asian rice economy in the 1970s, Barker and Herdt wrote: “Most Asian rice farms are small ... and employ intensive labour practices in place of mechanisation ... [R]ainfall is the dominant climatic variable, and the rice crop is normally limited to the rainy season ... Rice dominates not only production and consumption patterns, but is also inextricably woven into the social and economic fabric of life. More farmers are engaged in rice production than in any other single activity, with rice absorbing more than half of the farm labour force in many countries ... [Most] Asian rice economies lacked the capacity for technical change that would permit rapid growth in rice production to create the food surpluses needed for economic development” (Barker and Herdt 1985: 1–2).

That description certainly applied to the millions of rice farmers in the Lower Mekong Basin, where small-scale, labour-intensive, low-productivity, semi-subsistence farming systems predominated. While in parts of Asia, such as Central Luzon in the Philippines, Java in Indonesia, and the Central Plain in Thailand, rice farmers were widely adopting

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modern, high-yielding varieties, in the Lower Mekong traditional, low-yielding varieties still predominated (Barker and Herdt 1985: 63). The low productivity and subsistence orientation of Lower Mekong farmers not only reflected the persistence of traditional farming norms and practices but, in the case of Indochina (Vietnam, Laos, and Cambodia), the havoc wreaked on the rural population and landscape by decades of war, and the disincentives and hardship subsequently introduced through the imposition of collective forms of agriculture. Rural poverty and the threat of famine were rife.

In the 40 years since, rice farming in the Lower Mekong has undergone a dramatic transformation. This transformation can be characterised as “commercialisation” in the broadest sense, meaning the opening up of semi-subsistence rice farming to domestic and international input and output markets and the corresponding adaptation of farmers to the associated opportunities and risks. The process of commercialisation has thus included:

- the increased utilisation of externally produced inputs, including high-yielding seed, fertilisers, pesticides, irrigation, energy, machinery, and machinery services, as well as the credit needed to finance many of these purchases;
- the increased production of a marketable surplus, hence the choice of rice varieties, cropping systems, and processing technologies to meet the requirements of domestic and export markets;
- the progressive removal of state-imposed controls on rice farming in the socialist states of Indochina, including collectivisation of production, forced deliveries, land-use controls, price controls, and yield and production targets;
- the greater role of commercial decisions in farm management—for some farmers entailing specialisation in intensive, commercial rice production and, for others, prompting diversification away from rice production to field crops, tree crops, horticulture, and aquaculture, as well as non-farm pursuits.

This book is about understanding the processes involved in this transformation and the commercial opportunities and challenges of rice-based farming systems in the Lower Mekong in the 2010s, with a view to outlining prospects for the 2020s. It is the result of a collaboration between agricultural economists working in the four principal Lower Mekong

countries—Thailand, Laos, Cambodia, and Vietnam. The motivation for this research was to (a) compare the current situation and trajectories of rice farmers within and between different regions of the Lower Mekong, (b) explore the value chains linking rice farmers with input and output markets within and across national borders, and (c) understand the changing role of government policies in facilitating the on-going evolution of commercial rice farming. The role of this chapter is to set the scene for the specific studies that follow. Subsequent sections of the book deal in turn with studies of rice farming, value chains, and policies in Thailand's Northeast Region, the Central and Southern Regions of Laos, the Central Plain of Cambodia, and the Mekong Delta in Vietnam. The setting for these studies and the methods used are described in each section. A final section draws together the findings and implications of the research for rice policies in the region as a whole.

THE LOWER MEKONG BASIN

The Mekong River runs for 4500 km from the Tibetan Plateau to the South China Sea and Gulf of Thailand, draining an area of 810,000 km² that takes in parts of Yunnan Province in China and Myanmar, Laos, Thailand, Cambodia, and Vietnam in Southeast Asia (Fig. 1.1). This drainage basin is generally divided into the Upper Mekong (or Lancang Basin) in China, accounting for 20% of the catchment, and the Lower Mekong in Southeast Asia—the region with which this book is concerned—accounting for 80% of the catchment (Cosslett and Cosslett 2018; MRC 2019).

The Lower Mekong Basin comprises four physiographic zones (Cosslett and Cosslett 2018; MRC 2019):

- The Northern Highlands include upland regions in eastern Myanmar, northern Thailand, and northern Laos. Major left-bank tributaries include the Nam Ou, Nam Song, Nam Khan, and Nam Ngum in Laos and right-bank tributaries include the Nam Mae Kok and Nam Mae Ing in Northern Thailand.
- The Khorat Plateau is a large area of low-lying terrain with sandy soils mainly in north-eastern Thailand but including the lowlands of central and southern Laos. Left-bank tributaries include the Nam Ca Dinh, Se Bang Fai, and Se Bang Hiang in Laos and right-bank tributaries are the Songkhram and Mun Rivers in Thailand. The left-bank

Fig. 1.1 Mekong River Basin. (Source: CartoGIS, Australian National University)

tributaries drain high-rainfall areas and contribute to major wet-season flows, while the right-bank tributaries drain low-relief areas of lower rainfall.

- The Tonle Sap Basin is a large alluvial plain that begins in southern Laos and takes in most of Cambodia. At the eastern edge of the Basin, the main river breaks up into a complex network of channels. The Tonle Sap River and Lake make up the central and western parts of the Basin. During the dry season the Tonle Sap Lake drains into the Mekong via the Tonle Sap River, while during the wet season the high flows in the Mekong cause the Tonle Sap River to reverse direction so that the Lake increases sixfold in area and 40–50 times in volume.
- The Mekong Delta begins near Phnom Penh where the Bassac River, the largest distributary, splits from the main river. The Mekong and Bassac Rivers then split into a number of smaller watercourses as the delta expands into a wedge-shaped plain that covers an area of almost 50,000 km², nearly 80% of which is within southern Vietnam.

The Lower Mekong Basin has a tropical monsoonal climate, with high temperatures throughout the year and distinct wet and dry seasons. The climate of Laos is illustrative of the seasonal pattern (Fig. 1.2). There is a

Fig. 1.2 Mean monthly rainfall and temperature for Laos, 1991–2016. (Source: Climate Research Unit, University of East Anglia)

hot wet period from roughly June to mid-October, under the influence of the southwest monsoon; a cooler dry period from mid-October to mid-February, under the influence of the northeast monsoon; and a hot dry period from mid-February to May, encompassing the transition from the northeast to the southwest monsoon. The wet season starts and ends somewhat earlier in the northern part of the Lower Mekong than in the south, with corresponding adjustments in planting times. There is also a declining rainfall gradient from east to west, such that Northeast Thailand and Cambodia experience lower rainfall than Laos and Vietnam. Rainfed rice is frequently affected by drought early in the wet season due to variability in the transition between monsoons, and again late in the wet season if the regular monsoon rains end early (Schiller et al. 2006).

Reflecting this monsoonal climate, the flow down the Mekong follows a regular seasonal pattern that has been part of the rhythm of life along the river for millennia, with high flows and flooding during the wet season from June to November, peaking in August–September, and low flows during the dry season from December to May (Fig. 1.3). The flood season accounts for 80–90% of the total annual flow (MRC 2019). Most of the seasonal flooding occurs along the left tributaries in Laos and Cambodia, which drain mountainous areas of higher rainfall, as well as in the Tonle

Fig. 1.3 Average monthly mainstream flow at Pakse, Laos, 1960–2004 (cubic metres per second). (Source: Cosslett and Cosslett 2018)

Sap and the Delta. Cosslett and Cosslett (2018) highlight that, since 2000, extreme floods and droughts have become more common, along with sea-level rise, saline intrusion, and changes in runoff, attributable to natural climate variability, climate change, and the construction of hydro-power dams in the Upper Mekong. In a comprehensive review of the hydrological impact of hydropower dams throughout the Mekong, Hecht et al. (2019) confirm that the effect of the dramatic increase in main-stream, run-of-the-river dams since 2010 is to reduce and delay maximum flows in the wet season (hence the extent of flooding) and increase flows in the dry season, while reducing the overall delivery of sediment to the Mekong floodplain.

Most of the area of the Lower Mekong Basin falls in Laos (32%) and Thailand (29%), with Cambodia embracing 25% and Vietnam only 15% (Table 1.1). However, the population within the Basin is concentrated in Thailand (37%) and Vietnam (35%), with population densities of 132 and 279 persons per square kilometre respectively, compared with only 28 persons per square kilometre in Laos. Land use in the Basin is dominated by paddy fields (Fig. 1.4). Northeast Thailand accounts for just over half of the agricultural area of the Basin and just under half of the paddy land (Table 1.1). However, Vietnam has the highest proportion of agricultural

Table 1.1 Land, population, and rice production in the Lower Mekong Basin, 2014

<i>Variable</i>	<i>Thailand</i>	<i>Laos</i>	<i>Cambodia</i>	<i>Vietnam</i>	<i>Total</i>
Area in LMB ($\text{km}^2 \times 10^3$)	184.0	202.0	161.0	95.0	642.0
Area in LMB (%)	28.7	31.5	25.0	14.8	100.0
Population in LMB (2014) ($\times 10^6$)	24.2	6.1	12.5	23.0	65.8
Population in LMB (2014) (%)	36.7	9.3	19.0	35.0	100.0
Population density (persons/ km^2)	132	28	78	279	103
Agricultural area in LMB ($\text{ha} \times 10^3$)	10,300	1900	3100	4610	19,910
Paddy area in LMB ($\text{ha} \times 10^3$)	4647	631	1647	2606	9531
Paddy area as % of agric. area	45.1	33.2	53.1	56.5	47.9
Irrigated paddy area ($\text{ha} \times 10^3$)	1425	172	505	1921	4023
Irrigated area as % of paddy area	30.7	27.3	30.7	73.7	42.2
Paddy prodn. (2014) ($\text{t} \times 10^6$)	14.7	3.9	8.7	25.2	52.5
% growth of prodn. (2000–2014)	2.5	4.5	6.1	3.0	3.4
Average yield (2014) (t/ha)	2.6	4.3	3.1	5.9	3.8
Prodn. as % of country total	45	98	94	56	57

Source: Cosslett and Cosslett (2018, Tables 5.2, 5.3, 5.4 and 5.5)

Fig. 1.4 Land use in the Lower Mekong Basin. (Source: Mekong River Commission)

land in paddy production (57%), the highest proportion of paddy land irrigated (74%), and, with average yields of 6 t/ha, accounts for nearly half of total paddy production from the Basin. Production has grown steadily at 2.5 to 3% per annum in the major paddy regions of the Basin in Vietnam and Thailand, but has been accelerating in Laos (4.5%) and Cambodia (6.1%). Paddy production within the Basin accounts for around half of total production in Vietnam (56%) and Thailand (45%) but over 90% of total production in Cambodia and Laos. While the Basin contributes less than 10% of global rice production (being dwarfed by China and India), it accounts for just over a quarter of rice exports.

Demographic and economic change in these four countries has had a profound influence on the commercialisation of rice farming within the Lower Mekong Basin (Table 1.2). Fertility has dropped to below replacement rate in Thailand and Vietnam, and population growth has slowed to less than 1%, approaching zero in Thailand. The growth of population has also slowed to around 1.5% in Laos and Cambodia. Urbanisation of the population has increased to almost 50% in Thailand and over 33% in Laos and Vietnam. These changes have created a growing labour scarcity in rice farming.

All four countries have experienced rapid economic growth, beginning with Thailand, then Vietnam, and now Laos and Cambodia. While

Table 1.2 Demographic and economic data for Lower Mekong countries, 2018

<i>Variable</i>	<i>Thailand</i>	<i>Laos</i>	<i>Cambodia</i>	<i>Vietnam</i>
Population (millions)	69.037	6.858	16.005	95.541
Population density (persons per sq. km)	135.1	29.8	91.1	294.2
Population growth (%)	0.18	1.48	1.46	0.97
Fertility (births/woman)	1.46	2.62	2.52	1.95
Urban population (%)	49.2	34.4	23.0	35.2
Rice consumption (kg/person) (2011)	112	162	159	145
Gross national income (GNI) (USD billion)	410.5	15.6	19.8	206.7
GNI per capita	5700	2270	1230	2160
GDP growth (%)	4.1	6.5	7.1	6.8
Agriculture value added as % of GDP	8.7	16.2	23.4	15.3
Employment in agriculture (% of total)	30.7	68.0	30.4	39.8
Poverty headcount (%)	8.6	23.4	17.7	9.8

Source: World Bank Data, FAOSTAT, ILOSTAT

Thailand's growth has slowed to 4%, the other three countries have among the fastest growth rates in the world at around 7%. All countries are thus going through the agricultural transition associated with modern economic growth, with the agricultural sector increasing in absolute terms while its share of GDP has declined to 9% in Thailand, 15% in Vietnam, 18% in Cambodia, and 23% in Laos. Agricultural employment has fallen to 30–40% of total employment, except in Laos, where it remains high at 68%. Agricultural and economic growth has resulted in a decline in poverty, especially in Thailand and Vietnam, where the overall incidence is under 10%.

Increased incomes and urbanisation have brought about a decline in average rice consumption per capita in Thailand and Vietnam as households diversify their diets, and this tendency appears to be beginning in Laos and Cambodia. Nevertheless the growth in urban populations has increased the aggregate domestic demand for a marketed rice surplus, as well as for higher-quality rice. Similar changes in the rice-deficit countries of Asia have led to a corresponding growth in demand for rice exports from the Lower Mekong.

ORIGINS OF RICE FARMING IN THE LOWER MEKONG

Archaeological evidence indicates that rice (*Oryza sativa*) was fully domesticated and had become a staple in the lower and middle Yangtze by 4500 BCE (Fuller et al. 2010; Higham 2014). This subsequently led to the growth and spread of rice-growing populations into southern China around 3000–2000 BCE, and from there into Mainland Southeast Asia. It is probable that these early Southeast Asian rice farmers spoke languages of the Austroasiatic (Mon-Khmer) family, including the precursors of modern Khmer and Vietnamese. There is evidence for both a coastal expansion route, from southeastern China (modern Guangxi) to the Red (Hong) River and down the coast of Vietnam, and a riverine route, from southwestern China (modern Yunnan) down the Mekong to sites in the Khorat Plateau, the Tonle Sap Basin, and the Delta. These migrants brought with them a cultural package that included rice and millet; domesticated dogs, pigs, and possibly chickens; the preparation of yarn for weaving; a distinctive form of decorated pottery; and particular burial practices (Higham 2014). The rice they brought with them was of the *japonica* sub-species developed in the Yangtze, which they probably cultivated

under upland conditions, that is, without banded paddy fields (Bellwood 2011; Castillo 2011; Castillo et al. 2016).

Daic or Tai populations moved into the Lower Mekong Basin by various routes beginning in the first millennium CE, initially in response to the expansion of Chinese imperial control in southeastern China (Baker 2002; Stuart-Fox 2006). Originating in what is now Guangxi, some groups migrated westward into the northern arc of the Annamite Range, moving gradually across low ridges and into tributaries of the Red (Hong) and Black (Da) Rivers and of the Mekong. Others migrated further west into modern Yunnan, thence down the Mekong, Chao Phraya, and Salween valleys. Though escaping conflict was a factor, one of the prime motivators for these migrations was the search for good rice land (Baker 2002). Tai farmers had developed irrigation techniques suited to broad inland valleys, enabling streams to be diverted into a sequence of banded and sometimes terraced paddy fields, before rejoining the main river. This assured the water supply in the wet season and, where streams flowed year-round, permitted dry-season cropping. Such sites had already been occupied by Austroasiatic farmers such as the Khmu, who were gradually absorbed by the incoming Tai or displaced into the surrounding hills and mountains in the Northern Highlands and the Annamite Range, or the interior of the Khorat Plateau, though the Khmer remained dominant in the Tonle Sap Basin and the Delta (Evans 2002).

The *indica* sub-species of rice, which had evolved in the Ganges Basin through hybridisation with *japonica* rice from the Yangtze, was dispersed through Iron Age trade networks into Southeast Asia from around 500 BCE and eventually came to dominate lowland rice farming in the Lower Mekong, though *japonica* varieties persisted in upland sites, to which they were adapted (Castillo 2011). Mutations and farmer selection for preferred traits gave rise to thousands of *indica* landraces with varying heights, growing periods, resistances, and grain qualities, including the glutinous rices that became the preferred staple of Tai peoples in the Northern Highlands and Khorat Plateau and the fragrant rices that have formed the basis of high-value rice exports in recent decades.¹ By 500 CE, lowland rice farmers in the Mekong, whether Tai or Mon-Khmer speakers, were planting *indica* rices in banded paddy fields, cultivated with animal-drawn, iron-tipped ploughs—a technology that had been developed in the rice-growing heartland in the Yangtze but was also now prevalent in the Ganges Basin.

The diverse landraces cultivated by Mekong farmers were incorporated in a range of cropping systems to suit different agro-ecosystems, and these have persisted into the modern era (Barker and Herdt 1985, chap. 3; Javier 1997; Dao 2010; Haefele and Gummert 2015; Cramb 2017):

- Upland rice systems are practised on level to sloping land with no standing water, utilising medium to tall varieties of varying duration. These swidden or shifting cultivation systems are typically found in the Northern Highlands and along the Annamite Range, as well as in the northern uplands of the Tonle Sap Basin (Fig. 1.4).
- Rainfed lowland rice is the most widespread system in the Lower Mekong, involving bunded paddy fields with 5–50 cm of standing water in the wet season (subject to flooding or drought), utilising medium to tall varieties of varying duration. This is the dominant system in the open plains of the Khorat Plateau and the Tonle Sap Basin.
- Irrigated lowland rice includes (a) traditional gravity-fed irrigation using weirs to divert streams into adjacent paddy fields or dams (Northern Highlands, Khorat Plateau, Tonle Sap Basin); (b) lifting water from streams or canals to supply paddy fields using traditional devices such as waterwheels and scoops or (more recently) mechanical pumps, which are also increasingly used to tap groundwater (Khorat Plateau, Tonle Sap Basin, the Delta); and (c) tidal irrigation and drainage (middle reaches of the Delta). Irrigation can be used to supplement rainfall in the wet season and/or to enable dry-season production. Shorter-duration, photoperiod-insensitive varieties are preferred for the dry season.
- Deepwater/floating rice systems have been practised traditionally in areas that are deeply flooded in the wet season, such as around the Tonle Sap or the Plain of Reeds in the upper Delta. These systems utilise medium to tall varieties that elongate to 2–3 m in the case of deepwater rice or 5–6 m in the case of floating rice.
- Flood-recession dry-season rice systems are practised in areas that are continuously flooded in the wet season (such as around the Tonle Sap River and Lake and in the Mekong and Bassac branches of the upper Delta) and so not suitable for conventional rainfed or irrigated rice. Rather, the receding floodwaters are trapped by embankments and in ponds and dams that are used to irrigate a dry-season crop using canals and/or pumps.

HISTORICAL PERIODS OF SURPLUS PRODUCTION

These cropping systems provided subsistence for generations of small farming communities scattered throughout the Lower Mekong and were sufficiently productive to support the early Khmer, Cham, and Tai states that grew up in the first millennium CE and contended for power over the peoples and resources of the region in subsequent centuries (Evans 2002; Chandler 2008; Higham 2014). These states were all dependent on controlling labour and acquiring surplus rice to support state functionaries and invest in public works. Higham (2014: 390) refers to the fundamental importance of rice productivity, especially through permanent rice fields, ploughing, and irrigation, enabling the extraction of a rice surplus through taxation. On the other hand, Scott (2010) argues that swidden agriculture in the uplands provided a way for many to escape the exactions of centralised paddy states.

Funan, an early trading state in the Mekong Delta (c. 50–550 CE), and its successor, Chenla (c. 500–850 CE), likely depended on farmers producing flood-recession dry-season rice in sites such as Angkor Borei in what is now Takeo Province in Cambodia (Higham 2014: 278–285). Fox and Ledgerwood (1999) estimate that a farm workforce of 80,000 practising this system of cultivation could have supported an additional 40,000 people within a 10 km radius of Angkor Borei, utilising the system of canals that linked the rice-growing areas with the harbour at Oc Eo, adjacent to the Gulf of Thailand.

Angkor, the powerful Khmer state that expanded to control the Lower Mekong and beyond from 800 to 1350 CE, also depended in part on surplus production from deepwater/floating and flood-recession rice around Tonle Sap (Fox and Ledgerwood 1999). However, state-directed construction of large reservoirs (*baray*) and an extensive system of canals feeding into bunded paddy fields made irrigated rice possible, generating a large surplus (Helmerts 1997; Higham 2014: 349–407). An official Chinese visitor to Angkor in 1296–1297 noted “the cultivation of three to four rice crops a year” (Higham 2014: 390), perhaps referring to the combined crops from irrigated and flood-recession environments. A century earlier it was recorded that, under Jayavarman VII, Angkor’s 102 hospitals were supplied with 11,370 t of rice provided by 81,640 people residing in 838 villages, meaning the farmers produced nearly double their subsistence requirements in order to meet their tax obligations. The development of irrigated rice through construction of reservoirs and canals was

extended to other centres under Khmer dominance, including Champassak in what is now Southern Laos (Schiller et al. 2006).

The early Tai states (*muang*) established in the Lower Mekong from around 700 CE were also dependent on harnessing sites capable of producing surplus rice, such as the inland valley of Luang Prabang and the Vientiane floodplain. These sites were sufficiently productive to support the Tai state of Lan Xang that stretched across the Northern Highlands and the northern and eastern parts of the Khorat Plateau in the sixteenth century. However, the valleys controlled by Lan Xang had less productive capacity than the vast central plain of the Chao Phraya to the southwest, which supported the rise of Sukhotkai and then Ayudhya, ultimately at the expense of Lan Xang. Moreover, “there is little evidence that the [Lan Xang] state ever sponsored irrigation as a way of augmenting its economic surplus. The construction of dams and irrigation networks was left to local communities. The relatively small surpluses restricted the taxes and corvée (labour) that could be levied on the peasantry and thus the scale of public works that could be carried out, whether it be building roads or major temple complexes and cities” (Evans 2002: 12–13).

In the second half of the nineteenth century, the imposition of colonial rule and the surge in global demand for rice and other tropical commodities created a new set of circumstances favouring the production of rice surpluses. In the Lower Mekong Basin the growth in rice exports was based on surplus production in two regions of French Indochina—Cochinchina (embracing the Delta) and, to a much smaller extent, Battambang Province in western Cambodia. Exports of rice through the port of Cholon (now part of Ho Chi Minh City) averaged 157,000 t over the period 1863–1871, rising to 793,000 t in 1902–1911 and 1,314,000 t in 1930–1934 (Robertson 1936; Owen 1971), an average annual growth rate of 3% over 65 years.

Over 90% of these exports came from the Delta. The growth was stimulated by global demand, which led French and Chinese businesses to construct rice mills and Chinese traders to fan out into the Delta to purchase paddy from farmers. These farmers responded by producing increasing surpluses for sale—not through increased yields, which remained low at around 1.1 t/ha in the 1930s (Robertson 1936), but by expanding the area cultivated. The colonial regime invested in opening up the southern part of the Delta (the Trans Bassac) through construction of canals, encouraging in-migration of workers from poorer parts of Cochinchina as tenant farmers and labourers (Biggs 2012; Biggs et al. 2009). Thus the

area planted in Cochinchina increased from 200,000 ha in 1868–1870 to 1.7 million ha in 1911–1914, with the Trans Bassac increasing its share of planted area from 8% in 1872 to 37% in 1908 (Owen 1971). The population of Cochinchina grew from 1.2 million in 1867 to 3 million in 1910 (Owen 1971), a growth rate of 2.2%. This rapid growth reflected the influx of Vietnamese rice farmers as well as Chinese workers in the trading, milling, and exporting sectors of the industry.

In Cambodia, the French regime gave land concessions to French settlers for the establishment of large rice plantations in Battambang Province (Helmerts 1997). These concessions occupied over 16,000 ha and made use of hired labour to produce around 30,000 t of paddy per year. The government supported the plantations with irrigation infrastructure and a railway link to Phnom Penh, from where the paddy was shipped to Cholon for processing and export. The smallholder sector also contributed to the growth in exports, not through any increase in yields but through areal expansion. In the boom conditions of the 1920s, Khmer smallholders earned good incomes from rice sales but with the collapse in prices in the early 1930s, they responded by reducing the area cultivated by 60%. Over the first half of the twentieth century, the French regime obtained exports from Cambodia of from 50,000 to 200,000 t of paddy per year, mostly from smallholders.

The more isolated regions of the Lower Mekong in Laos and Northeast Thailand, which produced mainly glutinous rice for subsistence and the local market, contributed little or nothing to the pre-war export boom. Rice exports from Northeast Thailand accounted for only 7% of the country's rice exports in 1925 and 18% in 1935 (Ekasingh et al. 2007). For much of the colonial period, Laos was a net importer of rice, with only the Champassak area consistently producing a surplus (Schiller et al. 2006).

From the 1940s to the 1970s, war was the overriding factor affecting rice farming in the Lower Mekong. In Vietnam, under Japanese rule, the great famine of 1944–1945 resulted in between one and two million deaths due to failed harvests in the north and the forced acquisition and export to Japan of over a million tonnes of rice per year from the Delta (Gunn 2011). From 1945 to 1975, the First and Second Indochina Wars devastated the rural sector, despite attempts to boost rice production through land reforms and (in the south) the US-funded introduction of high-yielding varieties, fertilisers, and mechanisation. By the end of the war in 1975, there was a nation-wide production deficit of 2–3 million t of paddy (Le Coq et al. 2001). In Laos, too, despite high levels of US

assistance and the introduction and distribution of some improved varieties, rice production received little support and the escalating war disrupted and destroyed rural livelihoods.

In Cambodia, in the first decade after obtaining independence from France in 1953, and with support from United States Agency for International Development (USAID), paddy production increased to around 2.3 million t and rice exports to 250,000–400,000 t (Helmerts [1997](#)). From 1964, rice exports were nationalised and the government mounted campaigns to forcibly collect rice at the low official price, prompting armed rebellions by farmers in 1967 and 1968. From 1970 to 1975, Cambodia was caught up in the war, devastating rice production, which fell by 84%. Under the Khmer Rouge regime (1975 to 1979), despite a fanatical focus on developing intensive irrigated rice production through the mobilisation of labour in collective farms, the programme failed and the country was devastated, leaving the surviving population under threat of widespread famine by 1979 (Helmerts [1997](#)).²

During this period, Northeast Thailand was a remote and impoverished region but its strategic importance during the Indochina conflict led to substantial US-funded investment in roads, communications, irrigation, agricultural extension, and other forms of rural development. In particular, the Friendship Highway for the first time provided the region with a road link to Bangkok. These investments laid the foundation for the commercialisation of agriculture and diversification of livelihoods in the 1980s and 1990s (Ekasingh et al. [2007](#)).

RECENT CHANGES IN THE TECHNOLOGY OF RICE FARMING

The cropping systems that supported small communities, large empires, and colonial economies for two millennia, with little change in technology, have undergone significant changes since the mid-1970s, notably in (a) their relative importance, (b) the productive potential of the varieties cultivated, and (c) the extent of mechanisation (Cramb and Newby [2015](#)).

Upland rice systems have declined in extent, partly through government policies directed at eliminating shifting cultivation and partly due to declining productivity and the economic attraction of alternative crops (Cramb et al. [2009](#)). Deepwater and floating rice systems have also declined in importance. However, rainfed lowland systems have continued to dominate throughout the Khorat Plateau and the Tonle Sap Basin (Fukai and Ouk [2012](#)). There has been increasing use of on-farm irrigation

in some of these rainfed lowlands through digging small ponds and sinking tubewells, enabling supplementary irrigation of wet-season rice and dry-season cultivation of non-rice crops on a part of the paddy field. Particularly in Northeast Thailand, there has also been a shift in the use of the more drought-prone upper-level paddies to field crops such as cassava and sugarcane (Barnaud et al. 2006; Grandstaff et al. 2008).

Full-scale irrigated systems have expanded with public investment in irrigation infrastructure, especially in Thailand and Vietnam (Hoanh et al. 2009; Floch and Molle 2013; Schiller et al. 2006). While pump-irrigation schemes in the Khorat Plateau (both in Thailand and Laos) have not delivered the intended expansion in dry-season rice production, the development of flood control and irrigation infrastructure in the Vietnamese Delta has enabled the expansion of double and triple cropping of rice and, more recently, diversification into non-rice crops. Figures 1.5 and 1.6 show the current extent of rice cultivation in the wet and dry (irrigated) seasons.

Rice farming has also been transformed by the dissemination of modern varieties, giving higher and/or more stable yields, particularly in association with increased fertiliser use (Fukai and Basnayake 2001; Haefele and Gummert 2015). While the International Rice Research Institute (IRRI) had been working in Thailand from 1966, formal collaboration with the countries of Indochina did not begin until 1978 in Vietnam, 1986 in Cambodia, and 1987 in Laos. The succeeding decades of collaborative rice research in these countries and the growth of national rice breeding programmes have had a major impact on the development of locally adapted modern varieties.

The first high-yielding semi-dwarf variety, IR8, was made available in the Delta soon after its release in 1966.³ It was widely displaced by the more resistant IR36 in the 1980s and then by IR64 in the 1990s. With its wide adaptation, early maturity, and improved eating quality, IR64 was the ideal variety for commercial production. While IR64 is still widely planted, many more varieties with specific adaptations (e.g., flood tolerance, salinity tolerance) have been developed by local plant breeders and are being taken up by farmers (Bui and Nguyen 2017).

In Thailand, IR8 was not adopted because of its low eating quality, but the semi-dwarf gene in IR8 was incorporated in a series of locally bred varieties (labelled RD for Rice Department) that were widely adopted in the irrigated areas of the Central Plain. For the Northeast, the major breakthroughs were the selection of a line of Thai fragrant rice (*hom mali*,

Fig. 1.5 Area planted with rice in Lower Mekong Basin in wet season (July).
(Source: Mekong River Commission)

Rice Planted Areas in January

Fig. 1.6 Area planted with rice in Lower Mekong Basin in dry season (January).
(Source: Mekong River Commission)

KDML105) that since the 1990s has become the major commercial crop, and its mutagenesis to form RD6, a high-yielding glutinous variety that meets the subsistence needs of Lao farmers in the Northeast. These two varieties have formed the basis of what Grandstaff et al. (2008) have called a “rainfed revolution”.⁴ Rambo (2017) traces the social and economic consequences of this revolution.

In Laos, the rice breeding programme resulted in a suite of improved glutinous varieties that were widely adopted in rainfed and irrigated environments from the 1990s, resulting in a modest increase in yields, though the glutinous varieties have limited export potential (Inthapanya et al. 2006). Similarly in Cambodia, breeding programmes released selected lines of local varieties from the 1990s, used mainly for domestic consumption, though fragrant non-glutinous Cambodian varieties are also in demand in neighbouring countries (Javier 1997). Nevertheless, it is the short-term, high-yielding IRRI-derived varieties that dominate commercial dry-season cultivation in the south, supplying the cross-border trade with Vietnam (Wang et al. 2012).

The third major change in the technology of rice farming in the Lower Mekong has been the mechanisation of production, driven by the increasing scarcity and rising cost of farm labour. This began in Thailand in the 1960s but has since spread to Vietnam and is beginning to have an impact in Cambodia and Laos.

The earliest machines used in Thailand in the 1960s were locally made two-wheeled tractors for land preparation and low-lift axial-flow pumps for irrigation, mostly powered by tractor engines (Cramb 2019). Farmers acquired these machines themselves, given their low cost and multiple functions, but there was also some localised renting, particularly in the Northeast. Rather than mechanise transplanting, Thai farmers almost universally reverted to direct seeding to save labour, using hand broadcasting of pre-soaked seed in irrigated areas or dry seed in rainfed areas. However, in recent years some farmers have started to use seed drills or hire contractors who use transplanters. Hand weeding was progressively augmented or replaced with herbicides applied with hand-operated or powered backpack sprayers. Mobile threshers were successfully introduced in the 1970s and 1980s, mostly on a contract service basis. However, these were superseded from the 1990s by combine harvesters, also operated by contractors. The use of combines has entailed the delivery of harvested grain directly to mills, which have installed mechanical driers to deal with the high moisture content.

In Vietnam there was a parallel development of small-scale mechanisation, beginning in the mid-1960s with the local invention and rapid adoption of the engine-driven shrimp-tail pump, used for irrigation and drainage as well as to power boats (Biggs 2012). The success of the high-yielding variety IR8 gave added incentive to acquiring the pumps, especially in the context of the deteriorating hydraulic infrastructure in the Delta. However, small-scale mechanisation stalled after 1976 with the return of population to the countryside alleviating labour shortages, the collectivisation of machinery and other assets, and a renewed emphasis on large-scale, centrally controlled mechanisation (Le Coq et al. 2001; Biggs 2012). Moreover, commercial rice production was not remunerative, given the imposition of fixed supply contracts at low official prices. With market liberalisation from 1986, large farmers could purchase equipment such as pumps, hand tractors, and axial-flow threshers and provide contract services to poorer farmers. Mechanisation spread in the 1990s and 2000s so that by 2013 land preparation for rice was 95% mechanised, 50% of the rice crop was mechanically threshed, and 50% was harvested by small combines (Tran 2016).

Farmers in the rainfed and irrigated lowlands of Laos and Cambodia are beginning to adopt two-wheeled tractors, low-lift pumps, and combine harvesters, typically of Thai or Vietnamese manufacture. In Cambodia, much of the dry-season crop in Battambang in the west is mechanically harvested for immediate export to Thailand, and in Takeo in the south for export to Vietnam.

THE EVOLUTION OF RICE VALUE CHAINS

The changes in rice production systems have been associated with major changes in rice value chains (ACI 2005; Purcell et al. 2008; Reardon et al. 2014; Haefele and Gummert 2015; Swinnen and Kuijpers 2019), as summarised in Fig. 1.7. In the 1970s the value chain was relatively simple. Most of the inputs for rice production were supplied by the farm household itself or by neighbouring farmers, including seed, manure, draught animal power, and labour. To the extent that industrial inputs such as fertiliser or pesticides were purchased, these were typically provided on credit by a village trader who deducted the cost of the loan from the purchase of the crop. In some cases, especially in Thailand, government agencies provided these inputs, including credit. Paddy for household consumption was stored in the home compound and dehusked manually

Fig. 1.7 Schematic outline of evolving rice value chains in Lower Mekong Basin

as required or taken to a small-scale village rice mill. Paddy for sale was almost all purchased by a village collector who transported the crop to small or large commercial rice mills. Some of the crop may have been acquired by state purchasing agencies, whether to supply the bureaucracy or military, to accumulate disaster reserves, or to intervene in the market in an attempt to stabilise or support farm-gate prices. Once milled, rice was sold in bulk to wholesalers and then to retailers in urban markets, where it was sold loose to consumers and food outlets. In Thailand, large modern mills sold high-quality rice to export companies but in the 1970s and 1980s in Laos, Cambodia, and Vietnam the overriding concern was to produce enough rice for domestic consumption.

While these features persist in many parts of the Lower Mekong in the 2010s, there has been a “quiet revolution” in rice value chains that is still incipient in more remote regions but proceeding rapidly in the major surplus-producing zones (Reardon et al. 2014). Some of the key changes

are sketched here and explored in more detail in subsequent chapters (Fig. 1.7).

- Input and service providers have expanded to include seed, fertilisers, agrochemicals, irrigation equipment (pipes, hoses, tubewells), machinery (pumps, sprayers, tractors), and machinery services (tractor-hire, harvesting, digging ponds, sinking tubewells). These are increasingly provided by specialised suppliers (e.g., local contractors, dealers) and paid for in cash, through dealer finance, or using bank loans or microfinance rather than through tied credit from a local trader.
- The role of the village trader has declined, especially in Northeast Thailand, with increasing incidence of direct sales from farmers to medium-large mills. However, in the Delta, where harvested paddy is mainly transported by a network of waterways, local collectors still predominate, as they do in Laos and Cambodia. Contract farming of rice, whereby the mill provides seed, inputs, harvesting, and processing, has been introduced in some areas but with limited success.
- Rice mills are increasingly privately owned and financed rather than cooperatively or state-owned. Small mills are in decline, apart from their traditional function of custom milling paddy for local consumption, while farmers and traders increasingly sell to medium-large mills, implying transportation over longer distances on improved infrastructure. Larger mills, particularly in Vietnam and Thailand, have invested in expanding and upgrading milling equipment, enabling them to handle greater throughput, polish rice, and produce higher grades for both domestic and export markets. In Cambodia and Laos, though modern mills have been constructed in recent years, milling capacity remains a constraint.
- There is increasing coordination between large mills and urban wholesalers and (in Thailand and Vietnam) supermarkets. This provides a basis for sorting, packaging, labelling, and branding to meet the requirements of middle-class consumers, particularly in Thailand, for greater product differentiation and identification. There has also been growth in the processing of rice for both traditional food products such as rice flour and noodles and convenience foods such as rice crackers, though the supply of rice as a staple food remains the dominant chain.

- State procurement of paddy and rice for contingencies and price stabilisation continues to be a feature of the value chain in all countries. However, in Thailand this was taken to unprecedented lengths in the 2010s in an effort to support farm-gate prices and influence the world market, with disastrous economic and political consequences. Government-held stocks reached record levels by 2013 (13 million t) and have had to be progressively sold off at discount prices (Welcher 2017).
- The most remarkable development in the value chain has been not only the achievement of rice self-sufficiency in Vietnam, Cambodia, and Laos, but the overall growth in exports (Fig. 1.7), such that exports from the Lower Mekong Basin account for over 25% of global exports by volume. Exports from Thailand as a whole have increased from under 1 million t in 1975 to around 10 million t in 2016, over half of it now derived from expanded production in the Northeast. In Vietnam, exports recommenced within three years of the 1986 *doi moi* economic reforms, rising to an average of 6 million t in the 2010s (five times the volume of exports in the 1930s), over 90% of which is produced in the Delta. Cambodia and Laos have begun exporting on a much smaller scale in the past decade.
- An interesting aspect of the export value chain is the growth in cross-border trade in both paddy and rice between the four Mekong countries. This trade is two-way but is dominated by the flow of paddy from Cambodia into Thailand and Vietnam, where it is processed for both domestic and export markets.

SHIFTS IN RICE POLICY

While much of the process of commercialisation over the past 40 years has been driven by private actors throughout the value chain, shifts in government policy have been crucial (Byerlee et al. 2009; Chang 2009). The overriding concerns of governments in the Lower Mekong countries have been to achieve national food security (viewed as self-sufficiency in rice) and reduce rural poverty. In the 1970s these two goals coincided, given that subsistence was widely under threat (especially in the war zones of Indochina) and that impoverished rice farmers made up most of the population. However, given several decades of economic development, the two goals have increasingly diverged such that a continued emphasis on rice intensification can be at odds with the goal of poverty reduction. Farm

households in much of the Lower Mekong are now interested in more profitable non-rice crops and non-farm sources of livelihood. Moreover, the national self-sufficiency goal has been achieved in all jurisdictions, along with the infrastructure to ensure that rice-deficit areas can access supplies from surplus-producing areas. Hence, in the 2010s, government policies have gradually come to allow and even encourage greater farm diversification and to treat rice production as primarily a commercial activity, with the focus on upgrading value chains and promoting exports rather than merely attaining yield and production targets.

The range of policies pursued over this period can be conveniently broken down into: (a) those affecting *access* to resources (land, water, draught animals, machinery) and inputs (seed, fertiliser, services, information, credit); (b) those directly regulating farm *activities* (the organisation of production and the choice of crops, varieties, and cropping systems); and (c) those affecting the *appropriation* of the ensuing product (whether retained for subsistence, requisitioned by the state, sold at market prices, or taxed) (Ellis 1992; Chang 2009; Fig. 1.9).

In Northeast Thailand the emphasis was primarily on reducing rural poverty as Thailand as a whole was a rice-surplus country throughout the period under consideration (Fig. 1.8). The focus was on public investment

Fig. 1.8 Rice exports from Thailand, Vietnam, Cambodia, and Laos, 1975–2016. (Source: FAOSTAT)

Fig. 1.9 Influence of government policies on rice production

to provide access to the inputs (improved seed, fertiliser, extension, credit) and infrastructure (transport and irrigation) needed for independent smallholders to intensify rice production, to both safeguard their subsistence and generate a marketable surplus (Ekasingh et al. 2007). There was no attempt by the state to organise the production activities of farm households directly, though the establishment of marketing cooperatives was encouraged. With regard to the appropriation of farm income, 1976 marked a shift from taxing to supporting rice farmers. In that year the export tax on rice was abolished and the first price support programmes were instituted. The price support policy developed into a rice buffer stock scheme from 1981, intended to raise farm-gate paddy prices, and a paddy mortgage programme from 1983, financed by the Bank for Agriculture and Agricultural Cooperatives (BAAC) and using public warehouses or on-farm storage to carry over paddy stocks. With increasing subsidisation, more farmers participated (Ekasingh et al. 2007). However, as noted above, aggressive government intervention to support prices through this mechanism from 2011 to 2014 led to the accumulation of record stocks and the eventual collapse of the programme (Welcher 2017), though mortgaging newly harvested paddy for seasonal price stabilisation has recently been reinstated. A significant shift in government policy in the past two decades has been the promotion of sustainable and self-sufficient

agriculture within cooperative groups, including incentives for farmers to switch to organic rice production (Amekawa 2010), though this new emphasis has not had a great impact on the overall extent of commercial rice farming.

The economies of Vietnam, Laos, and Cambodia were centrally planned from 1975. Faced with an urgent need to raise rice production to avert famine, all three governments attempted to intensify rice production by exercising state control over access to resources and inputs, collectivising production activities, and appropriating much of the output at low official prices.⁵ The disincentives and inefficiencies created by this regime meant that rice production stagnated. In 1986 Vietnam introduced the *doi moi* reforms, which were soon emulated in Laos and Cambodia, whose 1986–1990 five-year plans were closely coordinated with Vietnam's.⁶ These allowed farm households to access inputs from the private sector (including imports), manage their own production activities, and sell surplus production at market prices. Though area, yield, and production targets are still a feature of government policy in Laos, and land-use controls to keep land in paddy production have persisted in Vietnam, the role of government has largely reverted to the Thai model of providing public goods through research, extension, and rural infrastructure (roads, canals, irrigation, electrification), subsidising key inputs (seed, fertiliser, water, electricity), and attempting to support or at least stabilise the farm-gate price of paddy while controlling the retail price of rice. However, the Vietnam state still plays a major role in rice marketing and exports through the Vietnam Food Association and state-owned enterprises, and has used floor prices, export quotas, and export bans in an attempt to control domestic stocks and prices (Nguyen and Talbot 2014; Tran and Dinh 2015; Nguyen et al. 2017; VNA 2018). Laos and Cambodia have also used export bans at times of high world prices with the intention of safeguarding food security.

NOTES

1. Genetic studies indicate that “glutinous *indica* landraces in Laos were generated through repeated natural crossing with glutinous-*japonica* landraces and severe selection by local farmers” (Muto et al. 2016: 580).
2. Despite the population being subjected to starvation rations, the Khmer Rouge regime appropriated rice for export, e.g., 150,000 t in 1976 (Chandler 2008).

3. Taiwanese advisors in the Delta with links to Taiwanese colleagues in IRRI were responsible for establishing experimental plots of IR8, and quantities of IR8 seed were distributed by the US military when replacement seed was urgently needed after flooding wiped out seedlings in a valley north of Saigon in 1967 (Biggs 2012).
4. In 1995, RD6 accounted for 40% of the total wet-season rice area in Northeast Thailand and 83% of the glutinous rice area (Ekasingh et al. 2007).
5. Collectivization in southern Vietnam after 1975 was incomplete—only 25% of farm households belonged to a cooperative in 1980, compared with 97% in northern Vietnam (Tsukada 2011). In Laos, too, the campaign to form producer cooperatives after 1975 had limited success, with most regarded as “pseudo cooperatives ... really only labour exchange groups” (Evans 1988: 76). In Cambodia, under the People’s Republic of Kampuchea (PRK), by 1986 “97 per cent of the rural population were in the collective sector which was composed of more than 100,000 solidarity groups each of which consisted of seven to fifteen families” (Sokty and Luyana n.d.). However, here too the effective extent of collective control over production activities is questionable.
6. In Laos the 1986 policy shift to a market-based economy was termed the New Economic Mechanism (NEM).

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