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Wet-Rice Agriculture and Economic Growth in Pre-Industrial Japan

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Staple Grain and Non-Staple Grain in the Japanese Economic Historical Context

Based on agricultural production and cultivated land data prior to modern Japan, this chapter analyses the impact of natural environment-induced differences in agricultural production conditions on regional economic growth and its trajectory. To this end, the chapter provides an overview of the agricultural production sector in Japan from pre-modern to early modern times. Agricultural production, especially rice cultivation, was the mainstay of pre-modern economic society. During this period, rice in East Asia was distinguished from other grains not only by being the staple grain but also by occupying a central position in the tax system as tribute. In the political history of Japan – at least during this period – the greatest concern of a governing organisation was how to control rice production and maintain its stable increase as tribute.

In this context, it should be noted that agricultural production, regardless of the crop, is influenced by the characteristics of the region in which it is produced. In pre-modern society, it was primarily soil and climatic conditions that determined the cultivation of crops. Although agricultural technology was developed to some degree, it could not fully control the effects of natural conditions. Given the uncertainty of natural conditions, year-to-year variations in temperature and precipitation would affect crops and sometimes create secondary obstacles, such as disasters, for the farmer, even if the crops were adapted to natural conditions.

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This scenario suggests that in pre-modern Japan, the main areas of staple grain production, especially the rice fields adapted to the geographical and climatic conditions, developed better economically than the non-rice fields and mountainous regions unsuitable for staple grain production. The relationship between areas where staple crops are grown and economic development can be attributed to the fact that rice has been considered an important tribute since pre-modern times. During this period, the Kinai region and the coastal areas of the Seto Inland Sea were considered the most developed agricultural areas. These areas are located in western Japan, which is characterised by a natural environment suitable for rice cultivation. Moreover, this area was under the control of a centralised Japanese government.

Although the ancient Japanese government aimed at strong centralisation, it disappeared from history due to the failure of its institutional structure. The political system in mediaeval Japan was decentralised and administered by individual political powers such as court nobles, temples, and shrines in the capital city of Kyoto. They ruled over their estates (*shōen*) throughout the Japanese archipelago. At this time, rice was still an important part of the annual tribute.

The rice produced in each region was transported to Kyoto, the seat of the rulers. Kyoto thus became the centre for the collection of tribute and an economic centre of Japan. After the Warring States period (from the late fifteenth to the late sixteenth century), Japan became a feudal state comprising the Edo Shogunate and other local lords (*daimyō*). Even during this period, rice was paid as an annual tribute tax. The *daimyō* sent the rice harvested in their territories to Osaka, where it was traded and distributed throughout Japan. Thus, since rice cultivation was important for tax purposes in pre-modern Japan, economic growth may have been determined by the growth of the agricultural sector based on rice production rather than the growth of the industrial and commercial sector.

However, in the middle of the Tokugawa period – the early modern period – Japan experienced progress in rural industrialisation and the promotion of commercial crop production throughout the Japanese archipelago. Since the eastern part of Japan is characterised by dry land and mountains that are not suitable for rice cultivation, rural industries such as sericulture grew in this region. This led to economic growth and an accompanying increase in population pressure. During this period, economic growth was affected by the production of commodity crops from non-paddy cultivation and staple crops from paddy cultivation. This

Figure 1 Regional Division in Japan Sources: Saito (1983) and Kito (1996)

means that the pattern of economic growth no longer relied on the production of staple grains, which depended on the natural environment, as it did in ancient and mediaeval times.

To explore the above concerns, this paper provides a quantitative overview of arable land and agricultural production before modern Japan, from the eighth to the nineteenth century, using primary quantitative data and estimates from previous studies. However, the quantitative analysis depends on the availability of data. Data were available for certain periods before the modern period. For example, national data were available in ancient times, and extensive micro-level and village-level data were available in the Medieval period. Regional data and macro-level data were not available in antiquity or the Medieval period. Due to the limited data availability, the results of a single reference year shall be used as a representative case for a long period, including the results of the reference year. In this context, it should be noted that an overview of long-term trends may lead to reconsidering the conventional theory that rice is Japan's main crop and new historical implications may be gained.

The remainder of this chapter is organised as follows. Section 2 reviews information on agricultural production in pre-industrial Japan. Section 3 examines the differences in agriculture across the Japanese archipelago

Table 1 Available Sources of Quantitative Information on Cultivated Area and Agricultural Output

Period	Source	Type	Contents	
Ancient period	Eighth century	(Documents of *Shōsōin*)	Official document	Individual land document.
	Tenth century	*Wamyōshō*	Ancient encyclopaedia	Area of paddy field by *kuni* (province).
	Twelfth century	*Shūgaishō*	Ancient encyclopaedia	Area of paddy field by *kuni* (province).
	––	*Shōchūreki*	Ancient encyclopaedia	(Alternative version of *Wamyōshō* and *Shūgaishō*).
	––	*Irohajiruishō*	Ancient encyclopaedia	(Alternative version of *Wamyōshō* and *Shūgaishō*.)
	––	*Kaitōshokokuki*	Korean diplomatic report	(Alternative version of *Wamyōshō* and *Shūgaishō*.)
Medieval period	Eighth-sixteenth century	Individual land document	Land management document	Individual land document.
Early modern period	Seventeenth-nineteenth century	(Documents of Tokugawa shogunate)	Official document	Cultivated area (paddy and non-paddy) and agricultural output.

Source Takashima (2017).

and regions. Section 4 examines how historical and regional agricultural conditions relate to the natural environment and how they affect economic growth. Section 5 concludes the chapter.

Information on Agricultural Production in Pre-Industrial Japan: Materials and Data

Among the historical materials on pre-industrial Japan, some materials can be analysed at the regional level, but most can only be analysed from the perspective of the entire Japanese archipelago. This analysis is appropriate given the limited data on the cultivated land area of paddy fields or rice production. Quantitative data on non-paddy fields are available in a single year for a limited number of small areas and villages, and it would be difficult to use these data to analyse regional characteristics within the Japanese archipelago (figure 1). This imbalance in data availability between paddy and non-paddy fields is the reverse consequence of the overemphasis on rice production as a tax by political rulers. The term *staple grain* reflects the bias towards rice, and therefore information is limited to paddy field agricultural production. However, an analysis of the gap in regional rice production can show the difference between the production

of rice and other crops, indicating the positioning of agricultural products other than rice.

Rice cultivation in Japan should be seen in the light of the political history of the region. The ancient Japanese regime was based on a political system called *Ritsuryō* (a system of laws and codes influenced by the Chinese political system) – the first centralised government in Japan. The *Ritsuryō* regime was established in the late eighth century by transferring the *Ritsuryō* system from China to the *Yamato* Kingdom, which was originally a confederation of great kings (*daiō*) and local powerful clans (*gōzoku*). Prior to the establishment of the *Ritsuryō* regime, individual clans owned land in the Japanese archipelago. After the establishment of the *Ritsuryō* regime, all land belonged to the emperor and was therefore considered public land. Under this system, arable land was distributed to farmers based on their respective family sizes. After the death of the cultivator, the land was returned to the government and given to another farmer (*handen shūju*). The farmers cultivated their allotted paddy fields (*kubunden*) and paid rice as land tax and various head taxes to the government. To maintain this system of land allocation, the old government set up a family register to record the details of each household, and land allocations were adjusted every six years according to the size and composition of each household. Thus, there is no doubt that the *Ritsuryō* government kept records of the condition of paddy fields throughout the country. However, data on the total land area of the entire archipelago in the eighth century, when the *Ritsuryō* government was established, are lacking. The unavailability of data can also be attributed to the fact that the older the period, the less likely it is that primary documentation will be available. Since paper was a precious commodity at the time, once a written record became redundant, the blank reverse side was often reused to create another record. The renewal of official documents such as land registers and family registers, which took place every 6 years, would therefore have resulted in the destruction of individual documents so that they could be reused as recycled paper for other purposes (Sakaehara 1991).

Quantitative data on paddy fields throughout the country became available around the tenth and twelfth centuries. These rare quantitative data were recorded in encyclopaedias, not in the official government documents of the time. These two centuries are the only time when data were collected at the country level, and therefore these data represent the only information available for the ancient period. There is no information on the non-paddy fields of the country during this period.

The *Ritsuryō* regime experienced internal contradictions in its rule from the eighth century onward, due in part to its institutional limitations. There was a transition from a centralised system of land control to a decentralised system in which the royal family, nobles, and powerful temples and shrines in Kyoto administered and levied taxes on the *shōen* located in various parts of the Japanese archipelago. This situation continued for about 600 years during the mediaeval period – the period of the *Shokuhō* regime (the government of Oda Nobunaga and his military and political successor Toyotomi Hideyoshi; '*shoku*' and '*hō*' are the initial letters of their family names Oda and Toyotomi, respectively) until the time when the Tokugawa shogunate (the Japanese feudal government headed by the shogun Tokugawa) was established in the seventeenth century. In the mediaeval period, due to dispersed land control in the archipelago, there were no records to determine the agricultural area of the entire archipelago or of each region, although there may be information on the management situation of the land in individual *shōen*. Although there are countless *shōen* documents, they are only individual cases and do not represent the entire district in which the *shōen* is distributed.

Documentation improved under the Tokugawa shogunate in the early modern period. The Tokugawa government was established after a long period of decentralised rule; it was based on a feudal system of government consisting of the Tokugawa shogun and his subordinate *daimyō*. Although the *daimyō* collected annual tribute each year from the land they ruled, each *daimyō* was expected to keep records of the area of land cultivated and the amount of crops harvested each year. For this reason, there are no detailed records at the national level. In fact, information on total and regional cultivated area in the early modern period can only be captured by the records of *kuni*-level (paddy and non-paddy) fields in 1721. The public documents provide a continuous record of cultivated land by narrowing the reference year. However, as in the mediaeval period, these public documents contain data at the individual level and not at the area or archipelago level. Therefore, these documents were not included in this chapter. Data on agricultural production – expressed as *kokudaka* (crop yield expressed as rice value) – are available at the national and regional levels for the years 1598, 1645, 1697, and 1830. Because agricultural productivity increased during the Tokugawa period as agricultural technology developed, it is difficult to say whether the *daimyō* kept records of all agricultural crops produced during this period due to technological advances. It is believed that there was a surplus of 20 to 30 percent from

the recorded number, and this surplus was more than 50 percent in some regions.

The Tokugawa shogunate was overthrown by the Meiji government, which made *fukoku kyōhei* (enriching the country and strengthening the military) its prime motto. It also initiated measures to modernise government accounting in order to increase the sustainability of the administration charged with the nation's construction. Although official statistical books including agricultural production were also compiled and published, the survey method, and commodities produced were not uniform. This can be attributed to the results of trial and error in the early stages. However, data on the use of arable land can be estimated by analysing prefectural, regional, and field data. Since agriculture has not changed significantly since the Tokugawa period, it can be said to reflect the situation of cultivated land just before industrialisation.

The numerical uncertainties in the above-mentioned historical documents have often been the subject of discussions on quantitative economic history. Academically, several historians, including the author, have made efforts to estimate actual production asymptotically. Generally, however, this chapter uses the data in the primary records rather than the results of historical estimates in previous studies. This is because the available estimates of agricultural production on cultivated land are at the national and regional levels. These estimates are considered symmetric and preliminary and are therefore inappropriate for detailed discussion (Takashima 2017; Bassino et al. 2019). However, as described at the beginning of this chapter, it is important that regional data be collected, even if they are raw data. The study considers them sufficient to outline the long-term trend.

Distribution of Arable Land Before the Modern Period

Ancient Period

Despite limited data, it was possible to determine the distribution of paddy fields in ancient period. Table 2 shows the distribution of paddy fields by region in the tenth and twelfth centuries. As shown in figure 1, the Japanese archipelago is divided into fourteen different regions (excluding Ezochi and Ryukyū, which were outside the effective control of Japan before modern period). As for the beginning of the eighth century (at the beginning of the Nara period), when the first centralised state emerged, the study referred to the estimated value of the cultivated area of the

Table 2 Area of Paddy Fields, 730–1150 (in *chō*)

Region		730	950	1150
East Japan	East Tōhoku	—	51,437	45,077
	West Tōhoku	—	26,137	42,120
	East Kantō	—	103,345	101,561
	West Kantō	—	108,497	122,543
	Tōsan	—	49,769	27,692
Mid Japan	Niigata and Hokuriku	—	77,820	98,537
	Tōkai	—	50,793	59,866
West Japan	Kinai	—	56,249	47,612
	Around Kinai	—	111,289	116,818
	Sanin	—	31,210	32,322
	Sanyō	—	66,246	94,029
	Shikoku	—	42,899	44,186
	North Kyūshū	—	68,927	66,655
	South Kyūshū	—	38,382	32,012
East Japan		—	339,184	338,994
Central Japan		—	128,613	158,403
West Japan		—	415,201	433,634
West Japan (incl. Mid Japan)		—	543,814	592,037
Total		663,001	882,998	931,031

Sources and notes Takashima (2017). No regional data were found in 730; only estimates at the national level are available. Figures for 950 are taken from *Wamyōshō* and *Shūgaishō* in 1150. Since *Wamyōshō* and *Shūgaishō* have several editions with different numerical values, the average value is employed in this table.

entire Japanese archipelago, since data on individual regions were not available.

The total arable land in ancient Japan grew 1.3 times during the period from 730 to 950 and 1.1 times from 950 to 1150, for a total growth of about 1.4 times during the entire ancient period. During the first 200 years, there was a remarkable increase in the area of paddy fields. This growth was influenced by the active cultivation policies of the *Ritsuryō* government in the eighth century. The most representative of these policies was *Konden einen shizai hō* in 743 (an edict that allowed farmers who established new arable lands to own them permanently). This policy not only aimed to increase the amount of newly created land by allowing private ownership of cultivated land, but also allowed the government to control cultivated land nationwide by including land other than cultivated land in its jurisdiction (Yoshida 1983). In the sense that it allowed private ownership of land, this land policy provided a high incentive for farmers, aristocrats, temples, and shrines to develop new cultivated land. The earlier

Table 3 Area of Non-Paddy Fields, 730–1150 (in *chō*)

	730	950	1150
Japan total	141,061	507,976	534,091

Source Takashima (2017).

Sanze isshin hō of 723 (a law that allowed peasants who created new arable lands to own it for a period of three generations) also had a positive effect on strengthening the *Ritsuryō* regime. This policy aimed to expand the arable land and increase rice tax revenues. The implementation of this policy involved granting land ownership to peasants and keeping records of such land allocations (Haneda 1961). There are examples of these land development efforts continuing into the ninth century. This agricultural policy had a positive effect on the expansion of arable land.

Despite these policies, there has been a decline in the growth rate of rice paddies from 950–1150. The annual growth rate of 0.03 percent in the latter two centuries was lower than the annual growth rate of 0.13 percent in the former two centuries. Thus, the growth rate of paddy fields in the ancient period was only 0.08 percent. This statistic is compared with the statistics after the transition to non-paddy fields in the archipelago in the same period.

Table 3 shows the estimated areas of non-paddy fields in the ancient period. Similar to paddy fields, the number of non-paddy fields increased during the ancient period. However, there was a difference between the growth rates of these two types of fields. In other words, the annual growth rate of the paddy fields was 0.08 percent, while the growth rate of the non-paddy fields was much higher at 0.32 percent. The area of non-paddy fields almost quadrupled in 400 years, while the area of paddy fields grew only 1.4 times. Although the acreage statistics are estimates, the growth of acreage in ancient Japan is attributed mainly to the development of non-paddy fields. This is consistent with a study reporting that the Japanese government actively promoted cultivation on non-paddy fields, or dryland, during this period (Haneda 1961; Miyamoto 1998).

In the eighth century, land development laws and regulations provided incentives for private ownership of cultivated land. These laws ensured that development efforts shifted from large-scale development by the state or corresponding powerful temples, shrines, and nobles to small-scale development by individual farmers. However, due to limited civil engineering infrastructure, the development efforts of peasants during this period were limited to the reclamation of disturbed landforms, which re-

sulted in the development of only small-scale or low-yielding paddy fields (Kinda 1987). In other words, in the early phase of arable land development in the Japanese archipelago, development efforts focused on converting forests and uncultivated land into arable land. This development resulted in the creation of non-paddy fields as a preliminary stage, rather than the direct conversion of wilderness to cultivated land (Kimura 1992). This is consistent with the fact that the acreage of non-paddy fields was increasing at a higher rate than that of paddy fields. This is also supported by the fact that the growth rate of non-paddy fields was high from the eighth to the tenth century, when various laws and regulations on land development were issued by the government. This growth rate declined after the tenth century.

Although data on paddy fields by region are available for only two reference years (950 and 1150 in the latter half of the ancient period), these data show the area of paddy fields in eastern and western Japan. While the area of paddy fields in eastern Japan did not increase, the area of paddy fields in western Japan, including the middle region, showed an increasing trend. The difference in the development of paddy fields between eastern and western Japan is attributed to the following factors. First, it is attributed to the ruling system of the *Ritsuryō* regime in the archipelago. The *Ritsuryō* regime was originally based in the Kinai region (the five capital provinces around the ancient capitals of Nara and Kyoto). Therefore, the economic base of this regime was in western Japan. Albeit the ruling system of the *Ritsuryō* regime was instituted in the eighth century, after the mid-ninth century the rule was effectively established in eastern Japan, particularly in the Tōhoku region (the northeastern Japan farthest from Kinai). Although the *Ritsuryō* regime was able to control the archipelago institutionally, its rule was replaced by the aristocrats, temples and shrines, and an emerging samurai power in the second half of the ancient period (after the tenth century). This limited the political influence of the *Ritsuryō* regime to the Kinai region and its environs. Responsibility for developing the arable land shifted from the *Ritsuryō* regime to these new ruling forces. It seems obvious that paddy field development was driven under the latter regime as the power of temples and shrines in Kyoto, which owned the *shōen* throughout Japan, increased.

Second, the difference can be attributed to the geographical conditions of the archipelago. While there are many plains (e.g. alluvial land) suitable for rice cultivation in western Japan, there are mountainous areas and

Table 4 Percentage of Paddy Fields in the Ancient Period, 730–1150 (in %)

Region		730	950	1150
East Japan	East Tōhoku	—	1.2	1.1
	West Tōhoku	—	1.4	2.3
	East Kantō	—	10.1	9.9
	West Kantō	—	5.7	6.4
	Tōsan	—	2.5	1.4
Mid Japan	Niigata and Hokuriku	—	3.3	4.2
	Tōkai	—	2.9	3.4
West Japan	Kinai	—	8.8	7.5
	Around Kinai	—	4.7	4.9
	Sanin	—	3.3	3.4
	Sanyō	—	3.5	4.9
	Shikoku	—	2.5	2.6
	North Kyūshū	—	4.4	4.3
	South Kyūshū	—	1.7	1.4
East Japan		—	3.1	3.1
Central Japan		—	3.1	3.9
West Japan		—	3.7	3.8
West Japan (incl. Mid Japan)		—	3.5	3.8
Total		2.5	3.3	3.5

Sources and notes Takashima (2017). No regional data were available for 730; only estimates at the national level are available.

uncultivated wasteland in eastern Japan. Therefore, it is believed that the development of paddy fields in eastern Japan was difficult in ancient period when civil engineering technology was limited. Moreover, the lord of the *shōen* in Kyoto entrusted the local clans and powerful farmers with the administration of the *shōen*, and their control was dispersed throughout the archipelago. Under these circumstances, the main concern of the *shōen* ruler was to obtain a stable income, i.e. the share of the annual tribute. Therefore, their commitment to the *shōen* was low. Conversely, large-scale development of arable land, as occurred through river irrigation, required the exercise of political control over a large area; this power reached its peak in the early phase of the *Ritsuryō* regime (Kinoshita 2014).

This is also true for the ratio of paddy fields by region (table 4). Nationwide, there was an upward trend in the proportion of rice paddies during the ancient period, with the increase most pronounced in the late ancient period. In the latter half of the ancient period, the proportion of paddy fields levelled off in eastern Japan.

Early Modern Period (Tokugawa Period)

There is little data on cultivated land in the early modern period relative to data on the scale of agricultural production. The only existing documentation includes information recorded under the Tokugawa shogunate in 1721, the midpoint of the early modern period. Quantitative data on arable land at the nationwide level were not available until the beginning of the modern period, more than 150 years later. In the context of Japanese economic history, it has been pointed out that proto-industrialisation in Japan progressed from the mid-eighteenth century (Saito 1985). In this context, even these two limited benchmarks can provide sufficient evidence to understand how proto-industrialisation affected the expansion of arable land. Because data on paddy fields and non-paddy fields were collected during this period, it was possible to assess the change in cultivated land use from the mid-early modern period to the modern period (table 5).

In the second half of the Tokugawa period, cultivated land expanded for both paddy and non-paddy fields, resulting in an equal expansion of area at the national and regional levels of about 1.5-1.9 times. In the

Table 5 Arable Land from the Pre-Modern to the Early Meiji Period, 1721–1882 (in *chō*)

Region		Paddy fields		Non-paddy fields		Total	
		1721	1882	1721	1882	1721	1882
East Japan	East Tōhoku	183,648	273,927	154,102	232,315	337,750	506,242
	West Tōhoku	83,652	173,058	36,310	64,439	119,962	237,497
	East Kantō	117,202	181,956	136,315	161,437	253,517	343,393
	West Kantō	136,861	183,472	303,626	310,674	440,488	494,145
	Tōsan	76,727	91,102	94,060	118,827	170,787	209,929
Mid Japan	Niigata and Hokuriku	187,042	334,183	76,987	112,232	264,028	446,415
	Tōkai	94,436	198,798	70,358	126,064	164,793	324,862
West Japan	Kinai	82,101	110,384	36,150	34,923	118,251	145,307
	Around Kinai	187,928	286,943	83,245	78,366	271,173	365,309
	Sanin	52,060	84,367	24,616	38,049	76,676	122,416
	Sanyō	121,393	202,820	67,116	90,268	188,509	293,088
	Shikoku	84,590	142,793	61,020	115,728	145,610	258,521
	North Kyūshū	150,452	223,073	87,830	142,444	238,282	365,517
	South Kyūshū	85,724	142,518	87,036	228,470	172,761	370,988
East Japan		598,090	903,514	724,413	887,691	1,322,503	1,791,205
Central Japan		281,477	532,981	147,344	238,296	428,822	771,277
West Japan		764,248	1,192,897	447,013	728,248	1,211,261	1,921,145
West Japan (incl. Mid Japan)		1,045,725	1,725,877	594,357	966,545	1,640,082	2,692,422
Total		1,643,816	2,629,392	1,318,770	1,854,236	2,962,585	4,483,627

Source Nakamura (1968).

early modern period, which began in the seventeenth century, the population and arable land increased (Takashima 2017; Bassino et al. 2019). According to *Seiryōki*, the oldest agricultural book in Japan, said to have been written at the end of the mediaeval period, houses in rural areas in the mediaeval period were flanked at the back by mountains; these houses overlooked small valleys and households depended on river water. This means that in the pre-modern period, rice cultivation was practised in natural wetlands and development shifted from these areas to diluvial plateaus; later, from the sixteenth to seventeenth centuries, it shifted to alluvial plains. This led to a nationwide increase in arable land in the seventeenth century (Hayami and Miyamoto 1989; Saito 1989).

However, in the Kinai region, which has been an advanced agricultural region since ancient period, the growth rate of paddy fields was somewhat lower than in other regions, and the growth rate of non-paddy fields was slightly negative in the latter half of the early modern period. In the Kinai region, the alluvial plains that could be used as arable land were cultivated, which can be attributed to the progress in the development

Table 6 Increase of Arable Land from the Pre-Modern to the Early Meiji Period, 1721–1882 (in %)

Region		Paddy fields	Non-paddy fields	Total
East Japan	East Tōhoku	0.25	0.26	0.25
	West Tōhoku	0.45	0.36	0.43
	East Kantō	0.27	0.11	0.19
	West Kantō	0.18	0.01	0.07
	Tōsan	0.11	0.15	0.13
Mid Japan	Niigata and Hokuriku	0.36	0.23	0.33
	Tōkai	0.46	0.36	0.42
West Japan	Kinai	0.18	-0.02	0.13
	Around Kinai	0.26	-0.04	0.19
	Sanin	0.30	0.27	0.29
	Sanyō	0.32	0.18	0.27
	Shikoku	0.33	0.40	0.36
	North Kyūshū	0.24	0.30	0.27
	South Kyūshū	0.32	0.60	0.48
East Japan		0.26	0.13	0.19
Central Japan		0.40	0.30	0.37
West Japan		0.28	0.30	0.29
West Japan (incl. Mid Japan)		0.31	0.30	0.31
Total		0.29	0.21	0.26

Sources and notes Table 5. The figures denote the rate of increase in arable land from 1721 to 1882.

of arable land in the first half of the early modern period. Since agricultural production in the area was advanced in ancient period, the cultivable land reached its limit in the latter half of the Tokugawa period. The growth rate of paddy fields in the Tōsan region was extremely low compared to the other regions, which can be explained by the mountainous terrain of this region.

The region where there was a high growth rate of paddy fields is outside the Kinai region. The growth rate was higher in western Japan, including central Japan, than in eastern Japan. The annual growth rates were 0.19 percent, 0.37 percent, and 0.29 percent in eastern, central, and western Japan, respectively. The growth rate in central Japan was much higher than that in eastern and western Japan.

Regarding the expansion of arable land in central Japan, the expansion of paddy fields in the Niigata and Hokuriku regions and the expansion of paddy fields and non-paddy fields in the Tōkai region are plausible (table 7). Paddy fields in the Niigata and Hokuriku regions expanded approximately 1.7 times; in the Tōkai region, paddy and non-paddy fields expanded about 2.1 times and non-paddy fields expanded 1.8 times. In the Tōkai region, the expansion of non-paddy fields was more remarkable than that of paddy fields, mainly due to the expansion of non-paddy fields for commercial crops such as cotton cultivation during this period.

In Kinai, around Kinai, and in the eastern Kantō regions, the growth rate of paddy fields was low in the latter half of the Tokugawa period. However, it appears that the rate of conversion of original land into paddy fields was high in these regions, in contrast to the expansion of land development in the first half of the Tokugawa period. The proportion of non-paddy fields in the East Kantō and West Kantō regions was over 10 percent. This is due to the geography of the regions. The Kantō Plain is a stratum group of volcanic ash origin, called the Kantō loam layer, which is suitable for non-paddy cultivation.

Historical Analysis Based on Natural Environments and Political Background

Despite the temporal and regional data limitations in both the ancient and mediaeval periods, the available data clearly show that the Japanese archipelago as a whole continued to expand its arable land. Based on the available data, it can be said that the epochal phase of arable land expansion was reached in the first half of the ancient period and the latter half of the early modern period.

Table 7 Proportion of Arable Land (Paddy and Non-paddy) from the Pre-Modern to the Early Meiji Period, 1721–1882 (in %)

Region		Paddy fields		Non-paddy fields	
		1721	1882	1721	1882
East Japan	East Tōhoku	4.0	6.0	3.4	5.1
	West Tōhoku	4.2	8.6	1.8	3.2
	East Kantō	10.5	16.3	12.2	14.5
	West Kantō	6.6	8.8	14.6	14.9
	Tōsan	3.5	4.1	4.3	5.4
Mid Japan	Niigata and Hokuriku	7.4	13.2	3.0	4.4
	Tōkai	4.9	10.3	3.7	6.5
West Japan	Kinai	11.8	15.9	5.2	5.0
	Around Kinai	7.3	11.1	3.2	3.0
	Sanin	5.1	8.2	2.4	3.7
	Sanyō	5.9	9.8	3.2	4.4
	Shikoku	4.6	7.8	3.3	6.3
	North Kyūshū	8.8	13.1	5.2	8.4
	South Kyūshū	3.5	5.8	3.5	9.3
East Japan		5.0	7.5	6.0	7.4
Central Japan		6.3	11.9	3.3	5.3
West Japan		6.2	9.6	3.6	5.9
West Japan (incl. Mid Japan)		6.2	10.3	3,5	5.7
Total		5.7	9.1	4.6	6.4

Source Table 5.

This raises the question of how the expansion of cultivated land led to a long-term change in agricultural production. In the early modern period, the Tokugawa shogunate and feudal lords began to periodically measure crop yields *(kenchi*: cadastral survey) to secure their financial base. However, these data were not revised for some time after the introduction of the cadastral survey to measure the area and productivity of agricultural land. Therefore, these data do not reflect the actual increase in land productivity, i.e. the increase in cultivated area and harvested quantity due to land improvement and agricultural technology that occurred, until the next survey. Therefore, it is difficult to estimate the area cultivated and the amount harvested in a single year, even from records in primary documents at the village level. In fact, an unnatural increase is often observed in the year of the cadastral survey in which the target area is reviewed.

Given the limited availability of information in the agricultural sector, it would be more accurate to conduct a macroscopic and reference year analysis to observe the long-term trend. The reference year that can be

used in this analysis is the year for which the Tokugawa shogunate and feudal lords exist, rather than the time series data of a single year.

The rate of increase in *kokudaka* value between 1605 and 1644 was 0.09 percent, the lowest in the early modern period, although it was only a period of less than 40 years. When broken down by region, the rate of increase was generally low. This was due to the influence of the Great *Kanei* Famine (1640–1643). In particular, the national- and regional-level data obtained through large-scale land surveys by the East Tōhoku region had an extremely low growth rate of -0.48 percent. In fact, the effects of volcanic ash in Hokkaidō (Ezo) caused a poor harvest in the Tōhoku region in 1640, and the whole country experienced abnormal weather conditions such as drought and prolonged rainfall in 1641. The damage was particularly severe in eastern Japan, and the effects of this damage can be clearly seen (Kikuchi 1997). In the first half of the seventeenth century, several small and medium sized famines destroyed crops (Kitahara, Matsumura and Kimura 2012).

In the following period, from 1644 to 1697, agricultural production was relatively stable. The latter half of the seventeenth century was a period of recovery from the first half, which was marked by famine. In the latter half of the seventeenth century, Japan entered a period of social and cultural prosperity, the *Genroku* period (1688–1704). According to a popular theory of Japanese history, *Genroku* culture flourished due to the growth of urban population and industry in urban areas, which can be attributed to the development of commodity crops. This led to the growth of *Genroku* culture (Fukai 2012).

The culture was concentrated in the cities of Kyoto and Osaka in the Kinai region, which can also be explained by the geographical, economic and political context. Agricultural products such as rice as *nengu* (land tax) and local products and specialties collected in the *daimyō* area were brought to Osaka and traded from there throughout the country. As shown in table 8, agricultural production from the Kinai region accounted for only 6 percent of total production nationwide, and even if the Kinai region is included, the share would be less than 20 percent. In other words, the Kinai region functioned as a collection point for tribute, which had existed since ancient period, rather than a place of production. With the establishment of the feudal system of the shogunate and domains (*bakuhan taisei*) in the early modern period, the role of the Kinai region as the centre of the nationwide distribution network became clearer.

Table 8 Agricultural Output from the Pre-Modern to the Early Meiji Period, 1605–1873 (in *koku*)

Region		1605	1644	1697	1831	1873
East Japan	East Tōhoku	1,729,000	1,431,060	1,921,935	2,874,239	3,739,862
	West Tōhoku	870,000	965,674	1,126,249	1,295,324	2,076,048
	East Kantō	1,531,378	1,703,639	1,957,109	2,207,586	2,593,176
	West Kantō	1,963,524	2,286,892	2,699,617	2,975,388	4,747,434
	Tōsan	836,124	832,662	913,311	1,136,549	3,260,416
Mid Japan	Niigata and Hokuriku	2,428,449	2,644,431	3,008,195	3,622,489	4,231,738
	Tōkai	1,916,518	1,995,702	2,200,375	2,415,984	2,977,010
West Japan	Kinai	1,398,762	1,475,118	1,555,485	1,615,528	2,907,945
	Around Kinai	3,026,222	3,110,731	3,185,013	3,507,165	5,613,579
	Sanin	679,332	724,392	802,299	883,233	1,372,300
	Sanyō	1,537,914	1,586,478	1,807,604	2,559,582	3,617,902
	Shikoku	946,024	963,204	1,077,904	1,351,239	2,995,965
	North Kyūshū	2,125,510	2,025,973	2,186,681	2,569,636	4,157,528
	South Kyūshū	1,347,659	1,347,648	1,359,651	1,437,888	2,550,031
East Japan		6,930,026	7,219,927	8,618,221	10,489,086	16,416,936
Central Japan		4,344,967	4,640,133	5,208,570	6,038,473	7,208,748
West Japan		11,061,423	11,233,544	11,974,637	13,924,271	23,215,250
West Japan (incl. Mid Japan)		15,406,390	15,873,677	17,183,207	19,962,744	30,423,998
Total		22,336,416	23,093,604	25,801,428	30,451,830	46,840,934

Sources Figures for 1605–1831 taken from Takashima (2017); for 1873 from Nakamura (1968).

The period from 1867 to 1831, in the middle of the early modern period, marks the emergence of proto-industrialisation in Japan. Natural shocks, such as the Great *Kyōhō* Famine (1732–1733) and the *Tenmei* Famine (1782–1788), affected the entire Japanese economy. In the long run, however, agricultural production enjoyed a smooth increase nationwide. An important factor was the encouragement by local *daimyō* to produce local specialties on behalf of the eighth shogun, Tokugawa Yoshimune. The rise of the publishing culture also contributed to this growth. Several instructional books on agricultural techniques, called *nōsho* (agricultural books), were published and distributed throughout Japan. Even today, many agricultural textbooks can be found in warehouses in rural areas of Japan.

Between the two reference years, a great famine occurred. With 12,000 people starving to death in the *Kyōhō* Famine and over 300,000 starving to death in the *Tenmei* Famine, the impact of the famine on the economy and production was significant (Kikuchi 2014). In the long run, how-

Table 9 Increase in Agricultural Output from the Pre-Modern to the Early Meiji Period, 1605–1873 (in %)

Region		1605-1644	1644-1697	1697-1831	1831-1873
East Japan	East Tōhoku	-0.48	0.56	0.30	0.63
	West Tōhoku	0.27	0.29	0.10	1.13
	East Kantō	0.27	0.26	0.09	0.38
	West Kantō	0.39	0.31	0.07	1.12
	Tōsan	-0.01	0.17	0.16	2.54
Mid Japan	Niigata and Hokuriku	0.22	0.24	0.14	0.37
	Tōkai	0.10	0.18	0.07	0.50
West Japan	Kinai	0.14	0.10	0.03	1.41
	Around Kinai	0.07	0.04	0.07	1.13
	Sanin	0.16	0.19	0.07	1.05
	Sanyō	0.08	0.25	0.26	0.83
	Shikoku	0.05	0.21	0.17	1.91
	North Kyūshū	-0.12	0.14	0.12	1.15
	South Kyūshū	0.00	0.02	0.04	1.37
East Japan		0.11	0.33	0.15	1.07
Central Japan		0.17	0.22	0.11	0.42
West Japan		0.04	0.12	0.11	1.22
West Japan (incl. Mid Japan)		0.08	0.15	0.11	1.01
Total		0.09	0.21	0.12	1.03

Sources and notes Table 8. The figures denote the rate of increase in the agricultural output.

ever, it can be said that the Japanese archipelago developed a degree of resilience to shocks from the natural environment and began to grow sustainably.

The period from 1831 to 1873 is the period from the latter half of the early modern period to the beginning of the Meiji period, that is, the transitional period of industrialisation. Interestingly, the growth rate of production in all regions was much higher than in the past. In eastern Japan, production increased 1.6 times in 40 years, while in western Japan, including central Japan, it increased 1.5 times. Although the rate of increase was high in each region, it was particularly striking in the Tōsan region, where the rate was outstanding at 2.54 percent; production increased by about three times. Tōsan was a major producer of sericulture in Japan, which was an important industry in the proto-industrial period. Raw silk became Japan's most important export due to the opening of ports in this modern transitional period. It is easy to imagine that the increase in production of such commodity crops also contributed to growth in other areas.

Table 10 Japanese Historical GDP Estimates by Main Sector, 730–1874 (in *koku*)

	Primary sector	Secondary sector	Tertiary sector	Total
730	7,267	466	689	8,422
950	10,108	613	943	11,664
1150	10,919	690	1,017	12,626
1280	9,813	666	1,091	11,571
1450	16,523	1,374	2,209	20,106
1600	30,678	3,652	7,306	41,635
1721	48,808	8,434	20,361	77,603
1804	58,803	10,091	24,402	93,296
1846	67,062	11,698	28,140	106,900
1874	76,351	15,782	36,043	128,176

Sources and notes Takashima (2017) and Bassino et al. (2019). The primary sector includes agriculture, forestry, and fishery industries. The secondary sector includes the mining and manufacturing industries. The tertiary sector includes the commercial and service industries.

This result also emerges from the production estimates, including non-agricultural production. Table 10 shows the long-term estimates of total output by sector from the ancient period to the early Meiji period. This estimate of sectoral output shows that production in all sectors (which stagnated during the mediaeval period) increased over period. In particular, from the latter half of the early modern period to the beginning of the Meiji period (1846 to 1874), the growth rate was extremely high. Interestingly, the proportion of the primary sector, which accounts for the largest proportion of total output, gradually decreased, while the proportion of the secondary and tertiary sectors increased. This trend was particularly notable in the transition period from the early modern period to the Meiji period.

Surprisingly, the share of the tertiary sector seemed to be higher than that of the secondary sector after the sixteenth century, as shown by the latest estimates of the Japanese historical national accounts (Bassino et al. 2019). This trend became even more pronounced after the eighteenth century. This indicates that proto-industrialisation led to a social transition that included not only industrialisation but also the development of the trade and service sectors.

But what if we look at this in terms of cultivated land and not in terms of an increase in production? What would happen if we plot the changes in cultivated land, as shown in tables 5 through 7? Figure 3 compares changes in the cultivated areas and agricultural production in the latter half of the early modern period. The rate of increase in agricultural pro-

Figure 2 Shares of Output by Sector, 730–1874
Sources Takashima (2017) and Bassino et al. (2019).

duction is plotted on the vertical axis and the rate of increase in cultivated land is plotted on the horizontal axis. In terms of regional characteristics, the increase in production in certain groups (Tōsan, Kinai, and West Kantō) is noteworthy, despite the low rate of increase in cultivated land. Among this group, Tōsan stands out in the graph, and it is necessary to investigate whether Kinai and West Kantō belong to this different group for the same reason as Tōsan.

Figures 4 and 5 show plots of figure 2 for paddy fields and non-paddy fields. Figure 4 shows the rate of increase in cultivated area for paddy fields only. In this case, the Kinai and West Kantō regions, which belong to a separate group with the Tōsan region in figure 3, are removed, and the characteristics of the Tōsan region become clearer. In contrast, figure 5 shows the graph when the rate of increase in the cultivated area is restricted to the non-paddy fields, in which case the Kinai and West Kantō regions are again included in the separate group with the Tōsan region. The East Kantō region is also included in this group. In the Tōsan region, the increase in cultivated area was small for non-paddy fields and paddy fields. However, in the Kinai and East and West Kantō regions, the area of paddy fields increased, while this increase was not evident in non-paddy fields. These results indicate that the increase in cultivated area did not

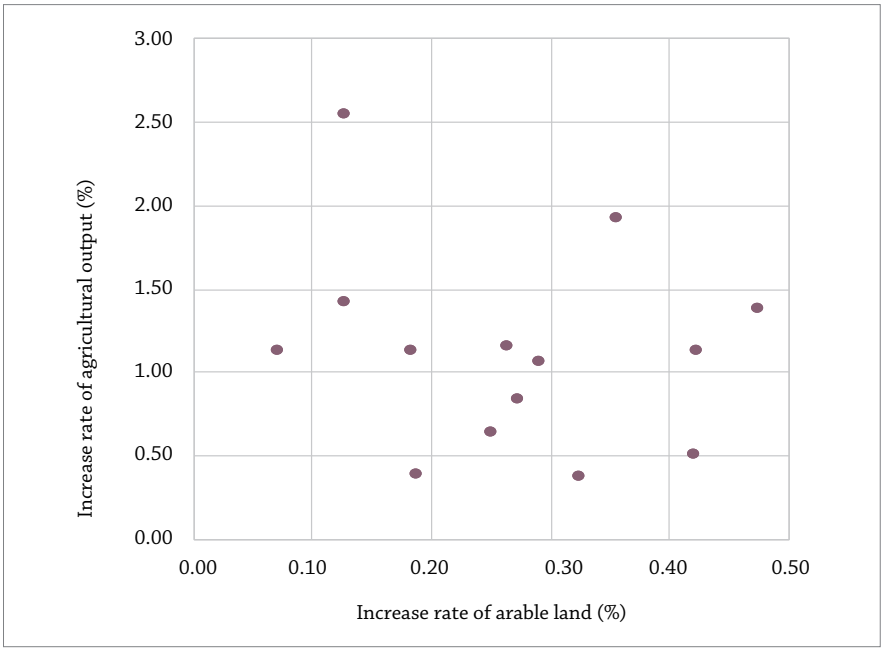

Figure 3 Increase of Agricultural Output vs Arable Land in the Latter Half of the Early Modern Period

Sources Table 8 and 9.

lead to an increase in production and that the increase in production was due to the increase in agricultural productivity, not cultivated area.

It is true that the yield of paddy fields compared to non-paddy fields is generally considered to be lower than that of land. However, the comparison with the production of main cereals and non-main cereals, such as millet, does not apply to commercial crops. It is also necessary to consider whether the cultivation area of non-paddy fields in the sericulture industry was determined on the same basis as that of the cultivation of other cereals. In fact, sericulture was very prosperous in the mountainous regions in the Tōsan and Kantō regions, which belong to this other group. The *kokudaka* value is a kind of numeraire that expresses the value of the crop produced on the land in units of rice. Therefore, the spread of commercial crop cultivation on non-paddy fields, which were originally unsuitable for growing main cereals such as grain, may have led to an increase in productivity, i.e. an increase in agricultural production.

This was a turning point in terms of the scale of paddy field agriculture in Japan since ancient period. In other words, rice remained the

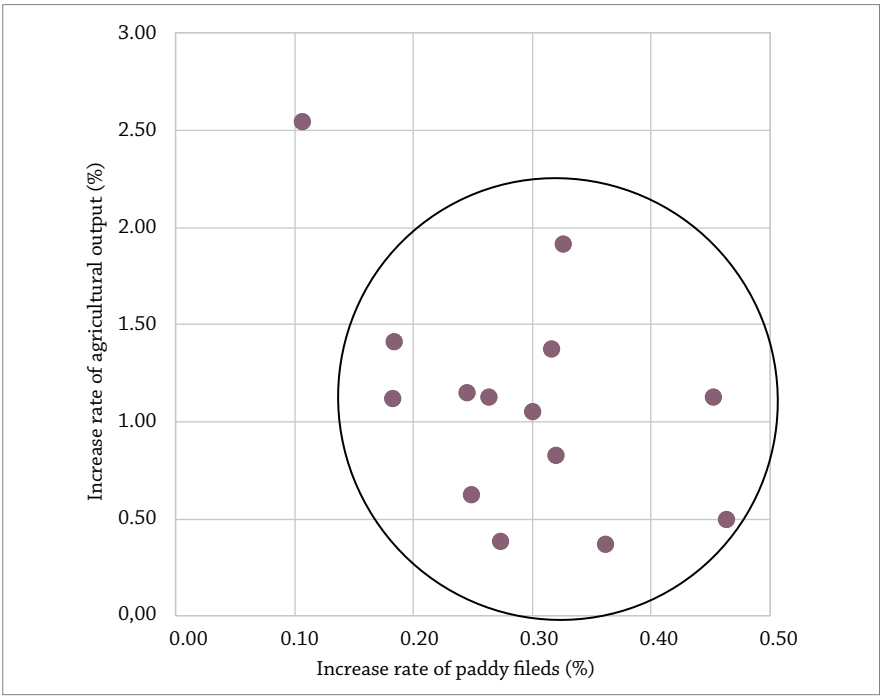

Figure 4 Increase of Agricultural Output vs Arable Land (Paddy Fields) in the Latter Half of the Early Modern Period

Sources Table 8 and 9.

predominant commodity as tribute in the middle of the Tokugawa period. However, the local *daimyō* encouraged the production of local specialties and sought to generate financial revenue by monopolising them in their domain. In local cultivation areas, some farmers produced commercial crops and purchased rice with the profits from the sale of commercial crops; they did not produce rice for self-sufficiency (Honjo 1994; Abe 1998).

Even when the Japanese archipelago is viewed from a broader perspective, the area of non-paddy fields in eastern Japan has not increased significantly. This can be interpreted in two ways. First, the sericultural industry in the mountainous areas has increased because of the high productivity of non-paddy fields. Second, there has been an increase in non-paddy fields, which are not cultivated land, in the sericulture industry. In any case, it can be said that the increase in agricultural production on non-paddy fields began in the latter half of the early modern period in the region characterised by lands unsuitable for main grain production.

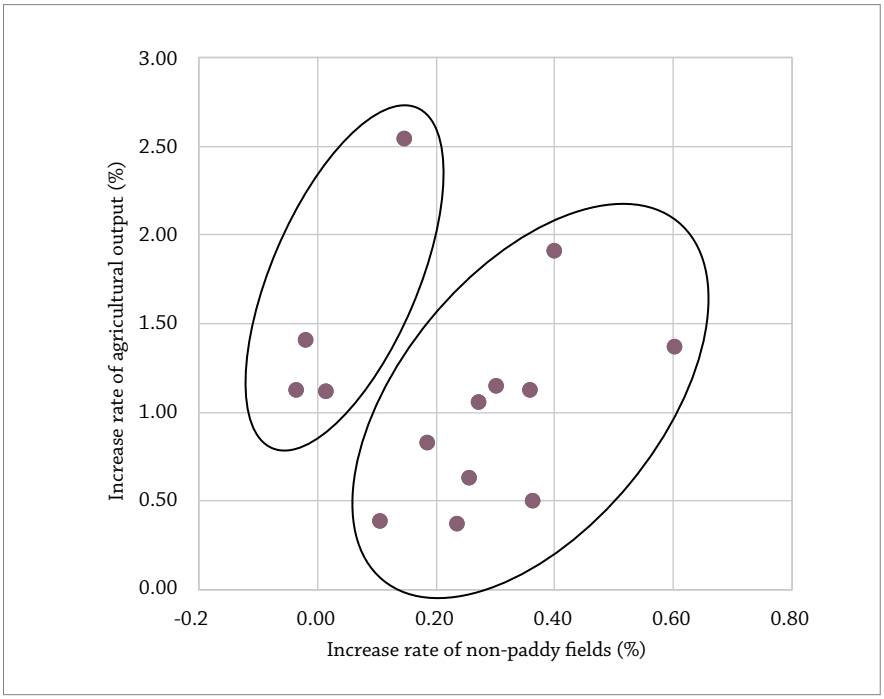

Figure 5 Increase of Agricultural Output vs Arable Land (Non-paddy Fields) in the Latter Half of the Early Modern Period

Sources Table 8 and 9.

In contrast, the rate of increase in non-paddy fields was higher in western Japan than in eastern Japan. However, this was due to the progress in commodity crop cultivation in the plains areas, especially in areas with high cotton production. In other words, the growth of agricultural production in non-paddy fields for commodity crop cultivation occurred in the latter half of the early modern period, but the distribution of this growth pattern varied from region to region, especially between the plains and mountainous areas.

This is more significant than the mere importance of the extent of non-paddy fields in terms of land use. In other words, pre-modern agriculture centred on paddy field agriculture was altered by political and commercial factors, not by changes in the natural environment.

As mentioned earlier, this is due to the political reforms under the leadership of the Shogun. In the mid-eighteenth century (*Kyōhō* Reform), Tokugawa Yoshimune encouraged the development of local specialties for each *daimyo* who ruled the Japanese archipelago. The financially poor

daimyō made an effort to develop local products. Of course, it cannot be said that all *daimyō* were successful, but in the first half of the nineteenth century it became possible to make profits by monopolising local specialties and selling them to other regions under the domain monopoly system (Yoshinaga 1996).

In other words, agriculture aimed at making profits from the commercial cultivation of crops on non-paddy fields changed the basis of the self-sufficient agricultural economy based on the hydroponic cultivation of rice, which had been dependent on the natural environment since ancient period. The use of arable land itself changed during this period, and the purpose of agricultural production changed with the large-scale introduction of commercial cultivation on non-paddy fields.

From this perspective, it is clear that the expansion of arable land in pre-modern Japan and its utilisation were greatly influenced by the taxation system of the government and local rulers of the era. Since agriculture in ancient period was highly dependent on the natural environment, hydroponic cultivation for rice produced at the optimum value was a pillar of agricultural production that was central to the tax system. Although local specialties were recorded in the government records of the period and were also supplied as tribute to the central government, they were only sufficient to satisfy the tastes of the aristocrats living in the central government. In this period, rice was the main tribute item and maintained its absolute status as a tax. In addition to rice, local specialties were also paid as tribute.

However, with the development of civil engineering and agricultural technologies, people were able to adapt the land to the natural environment, which led to the development of new cultivated areas and the expansion of production. Although there are no comprehensive quantitative data, it can be confirmed from the literature description that the cultivation of special commodities became popular in various places in the Japanese archipelago during the mediaeval period (Saito and Takashima 2017; Saito 2020). However, these commodities cannot be considered commercial crops that contributed to the tax system, as in the early modern period.

In the early modern period, the possible plains for paddy cultivation were almost developed, and the increase in land productivity led to an increase in agricultural production. Rice produced in the paddy fields was still collected as annual tribute, but feudal lords who could not enrich their financial status with rice alone sought a way out by growing commercial crops in non-paddy fields. In other words, pre-modern agriculture

at this time was changing from a tribute economy to a specialty economy. This movement is considered particularly noteworthy in non-staple grain-producing areas where paddy fields did not support the agricultural economy (Saito and Takashima 2016). Thus, the economic changes and growth in the proto-industrial period may have had a greater synergistic effect due to the intentions of the rulers.

Conclusions

This chapter reports on the changes in the area and use of arable land, and increase in production in pre-modern Japan, both at the macro and regional levels. In pre-modern Japan, the main cultivation areas for the staple grain, mainly rice paddies adapted to geographical and climatic conditions, were the first to develop economically. Historically, rice was considered an important tribute commodity since ancient period, and the natural conditions suitable for its production were the decisive factor for economic development. However, with the promotion of commercial crop cultivation, this pattern of economic growth changed. As a result, the agricultural production of commercial crops as well as the production of staple grain through the cultivation of paddy fields influenced economic growth. The reason for this was the institutional promotion of the cultivation of special products in the non-paddy fields to exchange for cash, in addition to the production in the paddy fields, which formed the basis of government taxation.

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