

## 日本の江戸期の米の生産と旱魃の関係

The relationship between rice production and drought during the Edo period in Japan

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**1.Introduction**

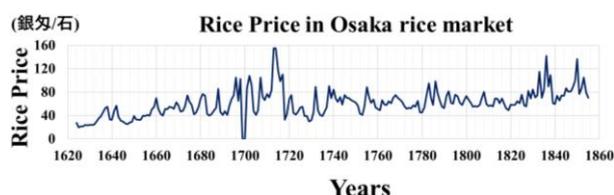
Paddy irrigation management in Japan has been recognized internationally as a successful example of Participatory Irrigation Management (PIM). According to Satoh (2021), this "success" results from an equitable water distribution within irrigated areas, even during drought, so that the yield of the entire irrigated area is not reduced. Then, he finds a relationship between the postwar rice harvest and annual rainfall in Japan and argues that the yields have rather increased in years with low rainfall and that during drought, water allocation within irrigation organizations is thoroughly coordinated and irrigation management conducted to avoid drought damage.

Such a management system had already been perfected during the Edo period when irrigation facilities were less developed. In fact, how was paddy irrigation development and management during the Edo period?

This study clarifies the relationship between rice prices and drought and other natural disasters during the Edo period and discusses paddy field irrigation development and irrigation management during the Edo period in Japan.

**2. Methods****2.1 Concept**

Based on previous studies and literature, annual data on rice prices during the Edo period and natural disasters were obtained from different



**Fig.1** Osaka rice price from 1624 to 1855

sources. The existence of a relationship was determined by comparing the data with each other. For rice prices, a year in which the rice price was 10% higher or more than the two years before and after was considered a high-price year. For natural disasters, the presence or absence of drought, floods, heavy winds, long spells of rain, and insect damage, were determined, also the month and the region in which they occurred. The relationship with rice prices was examined by comparison with high-price years.

**2.2 Materials****1) Rice price**

Among the many previous studies on rice prices during the Edo period, we used the annual rice price from 山崎隆三「近世物価史研究」(1983), which has been described by a recent researcher on early modern history as "a wide variety of rice price statistics relied upon and carefully worked on" and "undoubtedly a statistic that will continue to be a reference in the future "(Takatsuki, 2012). Like other previous studies, it's based on the rice price records in 草間直助「三貨図彙」(1815), which is organized mainly by representative brand rice in the Osaka rice market, using the average rice price from October to December after the harvest of that year as much as possible.

**2) Natural Disasters**

In the three-currency chart, years in which rice price increases were particularly pronounced, the factors behind these price spikes were identified. Next, we used 小鹿島 果「日本災異志」(1893). The book contains 12 categories of natural disasters and man-made disasters that have been recorded from ancient times to the Meiji period, with the date and area of occurrence, the extent of

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damage, and the source of information in chronological order.

In this study, drought, great wind, long rainy season, flood, and insect damage were selected as disasters that could affect rice prices in the Edo period, and their relation to the price of rice was determined. The sources used are mainly general histories, which were published before the three-currency chart and are considered to be independent sources of this "three-currency chart".

### 3. Results

#### 3.1 Fluctuations in rice prices

Rice price spikes occurred in 69 years out of 231, with no bias throughout the Edo period (Figure 1). Among these years, we've noted 4 years in which rice prices soared due to the shogunate's reduction of the silver content of rice silver coins (1695,1702,1713,1714) and 5 years in which government order merchants to buy rice for making rice price higher (1732,1745,1762,1807, 1813). The years excluding those years were considered years where harvests declined due to natural disasters. Thus, there has been a total of 60 years where there has been a price increase of at least 10% or more.

#### 3.2 Relationship with weather disasters

In 60 years with price increases, there have been 37 years in which "rice price spikes" have been mentioned in the three-currency chart, and among these, the factors that have caused the price spike have described 24 years of floods and long rainy seasons, and 4 years of drought. Table 1 shows the relationship between weather disasters and the rice price spikes of more than 10%. It shows that drought was recorded for 25 years, of which the year of the price spikes lasted seven years.

A  $\chi^2$  test was performed on this relationship, and  $\chi^2 = 0.14$ , indicating that there was no significant relationship between drought and the rice price spike. The same test with other disasters shows that for long spells of rain, the result was  $\chi^2 = 5.5$ , indicating a significant relationship to the 5% risk rate. The test was also carried out for

**Table 1** Relation between Rice price and disasters

Disasters	High Price	N/High Price	Total	$\chi^2$ Test
Drought	7	18	25	0.1
Flood	32	81	113	0.6
Great wind	33	70	103	2.6
Insects damage	3	5	8	2.0
Long rainy season	11	11	22	5.5

drought and floods by dividing the years into ranks according to the severity and extent of the disaster and selecting the years with the highest risk ranks, no significant relationship was noted.

### 4. Discussions

Rice prices fluctuated frequently and significantly. This indicates that rice production has been affected by natural disasters causing high fluctuation. The only years in which a drought-induced rice price spike could be confirmed were in the years 1641, 1726, 1756 and 1794.

One possible reason is that rice paddy development did not take place on a scale that greatly exceeded that frequently damaged by drought. As clarified by Arisawa (1963), while the shogunate aimed to increase tax revenues by maximizing the use of river water resources, it restrained development from its position as a "mediator" to avoid conflicts among regions during droughts. In addition, since rice paddy development requires investment in the construction of waterways and land preparation, it may have been economically constrained to develop more paddy areas under conditions that frequently cause damage.

Satoh (2021) points out that Japanese paddy irrigation organizations and rules may have ensured equal water distribution within irrigation districts to secure yields for the entire irrigation scheme by thoroughly using water watchdogs and repeated use during droughts since the Edo period.

This study represented the price of rice in the Osaka rice market as the price of rice in Japan as a whole, but rice prices in smaller regional markets might be more affected by crop failures due to disasters, which needs to be examined in the future.