

How did climate variations affect rice yields in Early Modern Japan? -comparison between tree-ring oxygen isotope data and Menjo (tax bill) records

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Recent progress in paleoclimatology enables us to investigate how climate changes affected society in the past, in collaboration with historical documents and/or archeological records. For example, Buckley et al. (2010) show that multi-decadal variations in hydroclimate are considered to be a contributing factor in the demise of Angkor. However, it is challenging to investigate how climate changes affected crop yields, which are directly linked to human life.

In the present study, we explored the relationship between climate variations and rice yields using tree-ring oxygen isotope ratios and Menjo (tax bill sent from a local lord) records in Early Modern Japan. A tree-ring oxygen isotope chronology was established using several trees collected from central Japan. By comparing with instrumental climate data, the chronology showed a significant negative correlation with summer precipitation and relative humidity. On the other hand, annual rice yields were estimated using Menjo records collected from a total of four villages, which were located along lakefront of Biwa Lake. Specifically, numerical data of Nokoridata, which is closely related to rice yield, were extracted from the Menjo records.

The tree-ring oxygen isotope data showed a significant positive correlation with mean rice yields estimated from Menjo records of four villages, indicating that increase in precipitation led to rising lake level of Biwa Lake, which in turn resulted in reduction of rice yields due to floods of crop fields.

(Reference)

Buckley, B. M., K. J. Anchukaitis, D. Penny, R. Fletcher, E. R. Cook, M. Sano, L. C. Nam, A. Wichienkeo, T. T. Minh, and T. M. Hong (2010), Climate as a contributing factor in the demise of Angkor, Cambodia, *PNAS*, *107*, 6748-6752.

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