## Influence of climatic fluctuations on crop production for 135 years in Japan

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Growing population requires more food supply under the projection of future climate change, which would give a large impact on agricultural production (IPCC, 2017). Avoiding the catastrophic situation induced by food shortage reminds us the importance of wise investment of limited economical and environmental resources onto the social infrastructure to secure the local-to-global sustainability. Global scale analysis, based on national crop statistics, showed that recent climate variation affected the crop production (Lobell et al, 2008, Hertel et al., 2010, etc.). However, conventional analyses are mostly based on the country-level data during the relatively short period, from 3 to 5 decades.

Japan's governmental department of agricultural administration (current Ministry of Agriculture, Forestry and Fishery) publishes long-term crop production data in the annual reports from 1883 to present for all 47 prefectures. To elucidate the long-term trend of crop production evolution and its correlation to climatic fluctuations, here we compiled the 135 year record during 1883-2017 on the production of six major crops (rice, wheat, barley, soybean, potato, sweet potato) in 46 out of total 47 prefectures, eliminating Okinawa prefecture, due to too low surface area of 6 nationally major crop cultivation and almost no record for few crops in pre WWII time to keep the consistency in statistical analysis. We analyzed those data on the following two topics, 1) The spatiotemporal distribution of growth crop production growth and potential stagnation, 2) The effect of climate on year to year fluctuation of crop production.

Annual production and area values of six major crops for each prefecture are collected from the printed books on National crop statistics as the photo copies through the National Diet Library Digital Collections (http://dl.ndl.go.jp) from 1883 to 1957, and from the Statistics repository e-Stat (www.e-stat.go.jp). Though long-term averaged yields all showed temporally gradual evolution, prefectural stagnation sign shows spatio-temporal variation in maturity of production evolution (Fig. 1). Potato and sweet potato show clear nation-wide stagnation in recent 4 decades (1981-2017). Correlation coefficients of yields to CRU-based climatology show remarkably that rice, soybean and sweet potato yields respond very positively to air temperature for long-term, and rice to precipitation in last 4 decades. Other wheat, barley and potato do not show particularly long-term climatic sensitivity. Cloudiness does not affect significantly to all 6 crops.

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