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Rice cultivation area changes related to introducing the integrated rice-fish system in China

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Abstract:

The integrated rice-fish system (RF) combining rice cultivation and aquatic organisms (fish, shrimp, crab, etc.) farming in the same paddy field is an important model for poverty alleviation and food production. However, the underlying reduced area for rice cultivation in the RF might have negative impact on food security. The present study analyses the rice cultivation area changes in China by comparing rice cultivation area in the RF system and the total paddy field area before introducing RF using satellite remote sensing data in Google Earth. Totally 30 National Integrated Rice-Fish Demonstration Zones were located in 15 provinces and 896 rice plots measured with a total area of 1,000 hectares. All the rice plots have characters of RF such as surrounding ditches. The results showed that after introducing RF, the rice cultivation area reduced to 57±17% (mean±SD, n=896) of the previous total paddy-field area. RF in provinces of Jiangxi, Henan, Anhui had lower rice cultivation area reduction than those provinces in Tianjin, Shandong, Zhejiang, Fujian, Shaanxi. RF established during 2016-2020 had lower rice cultivation area reduction than RF established before 2015, respectively (P<0.01). Previous studies have shown that after introducing RF, a 10% reduction in rice cultivation area has no significant impact on rice production. The state also set regulations that the ditches and pits of RF should not exceed 10% of the total paddy-field area. This study found that after introducing RF, the rice cultivation area had decreased about 40% compared to the previous total paddy-field area. The possible reasons for such high rice cultivation area reduction are that RF needs ditches and pits and additional areas for widening roads and reinforcing ridges. The effect of reduction in rice cultivation area on rice production and food security calls for further study.

Methods:

The present study analyses the rice cultivation area changes in China by comparing rice cultivation area in the RF system and the total paddy field area before introducing RF using satellite remote sensing data in Google Earth(Figure1.).Totally 30 National Integrated Rice-Fish Demonstration Zones were located in 15 pro-vinces and 896 rice plots measured with a total area of 1,000 hectares(Figure2.). All the rice plots have charac-ters of RF such as surrounding ditches(Figure3.).

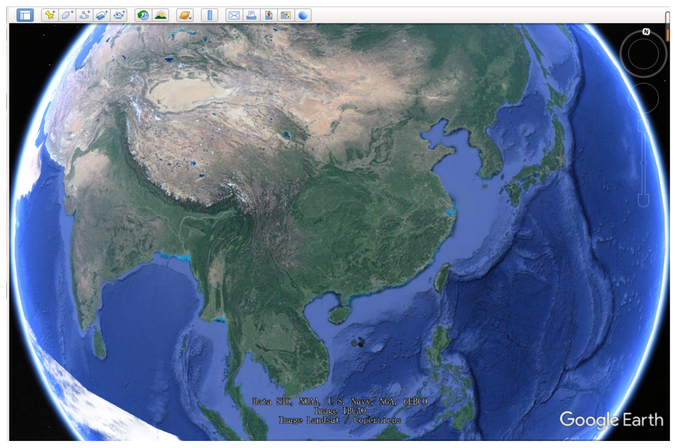

Figure1.Google Earth Panorama

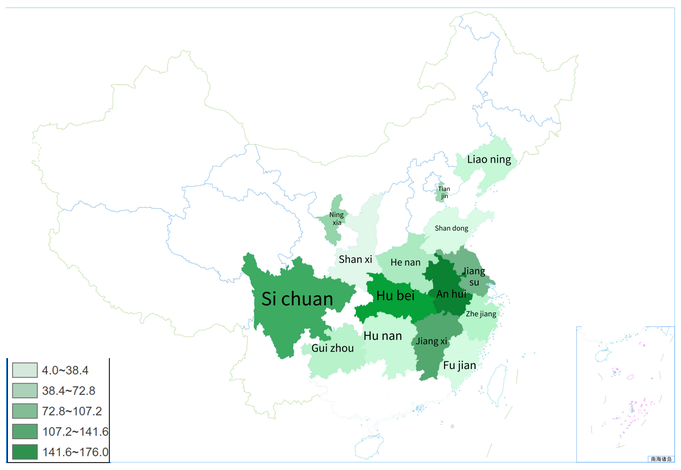

Figure2.Rice field data distribution

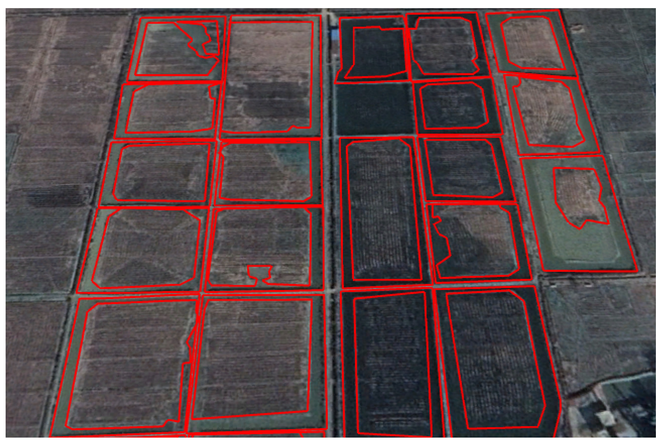

Figure3.Survey map of National Integrated Rice-Fish Demonstration Zones

Results:

The results showed that after introducing RF, the rice cultivation area reduced to 57±17% (mean±SD, n=896) of the previous total paddy-field area. RF in provinces of Jiangxi, Henan, Anhui had lower rice cultivation area reduction than those provinces in Tianjin, Shandong, Zhejiang, Fujian, Shaanxi(Figure4.). RF established during 2016-2020 had lower rice cultivation area reduction than RF established before 2015,respe-ctively (P<0.01)(Figure 5.). Previous studies have shown that after introducing RF,a 10% reduction in rice cultivation area has no signifi-cant impact on rice production.The state also set regulations that the ditches and pits of RF should not exceed 10% of the total paddy-field area. This study found that after introducing RF, the rice cultivation area had decreased about 40% compared to the previous total paddy-field area. The possible reasons for such high rice cultiva-tion area reduction are that RF needs ditches and pits and additional areas for widening roads and reinforcing ridges.

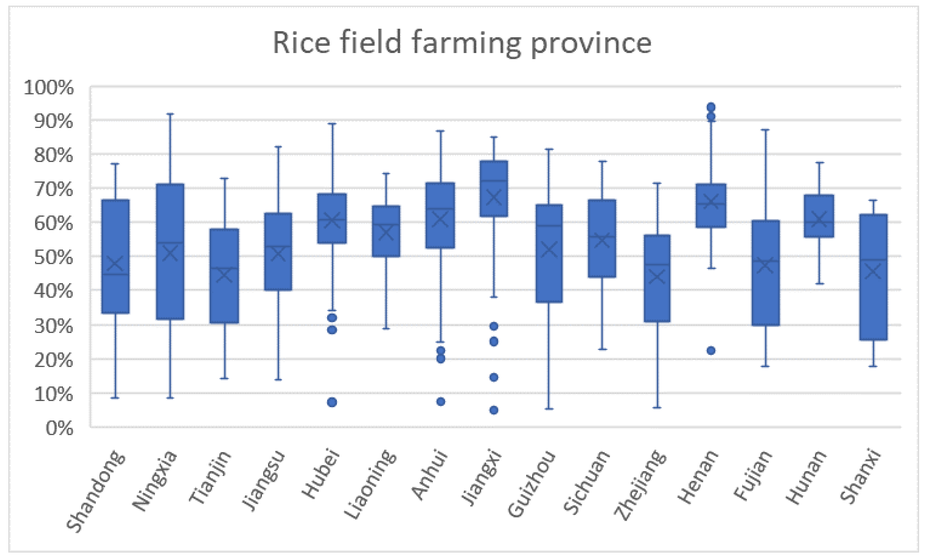

Figure4.Rice field farming province

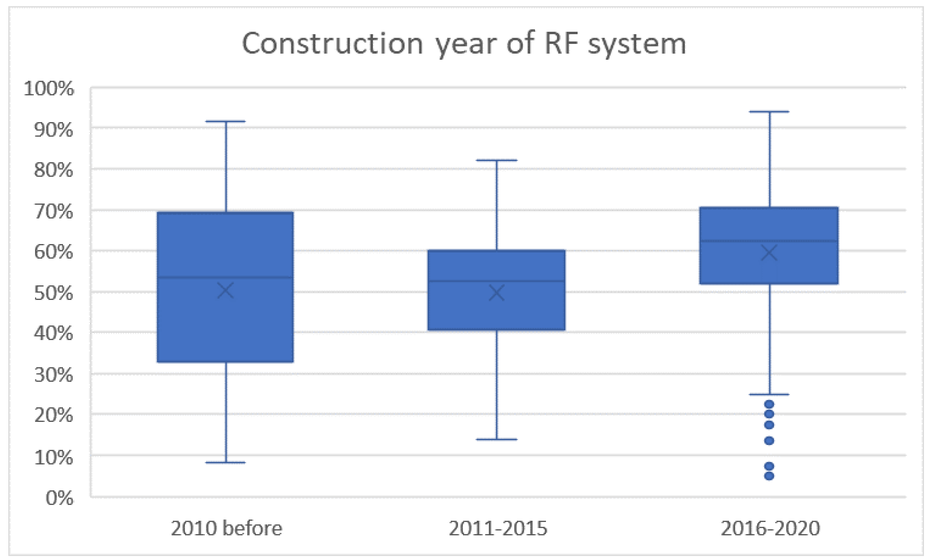

Figure5.Construction year of RF system

Discussion:

National standards and regulations on RF have detailed limitations for the proportion of water area after converting from previous paddle fields to new RF systems, primarily due to the intention to maintain rice production and food security concerns. However, the present study found that the water area in new RF systems only accounted for half of the reduction of rice farming. Another half of rice farming area reduction is due to reinforced rice/pond banks, ridges, and other new infrastructures such as roads and ditches.

As the present study is primarily based on visual observation of current and historical satellite images on Google Earth, this method has several limitations. This includes: 1) the geographic and timeline coverage of satellite images on Google Earth is insufficient to study all the National Integrated Rice-Fish Demonstration Zones. Among 67 Zones we have only identified and measured 30 of them; 2) The RF system's appearance varies from no water area in some RF systems to almost no rice farming area left, which looks like fish ponds. We only identified and measured those rice plots with typical characters of RF such as surrounding ditches.

Conclusion:

The effect of reduction in rice cultivation area on rice production and food security calls for further study.

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