remote sensing

# Supplementary materials: Different Agricultural Responses to Extreme Drought Events in Neighboring Counties of South and North Korea

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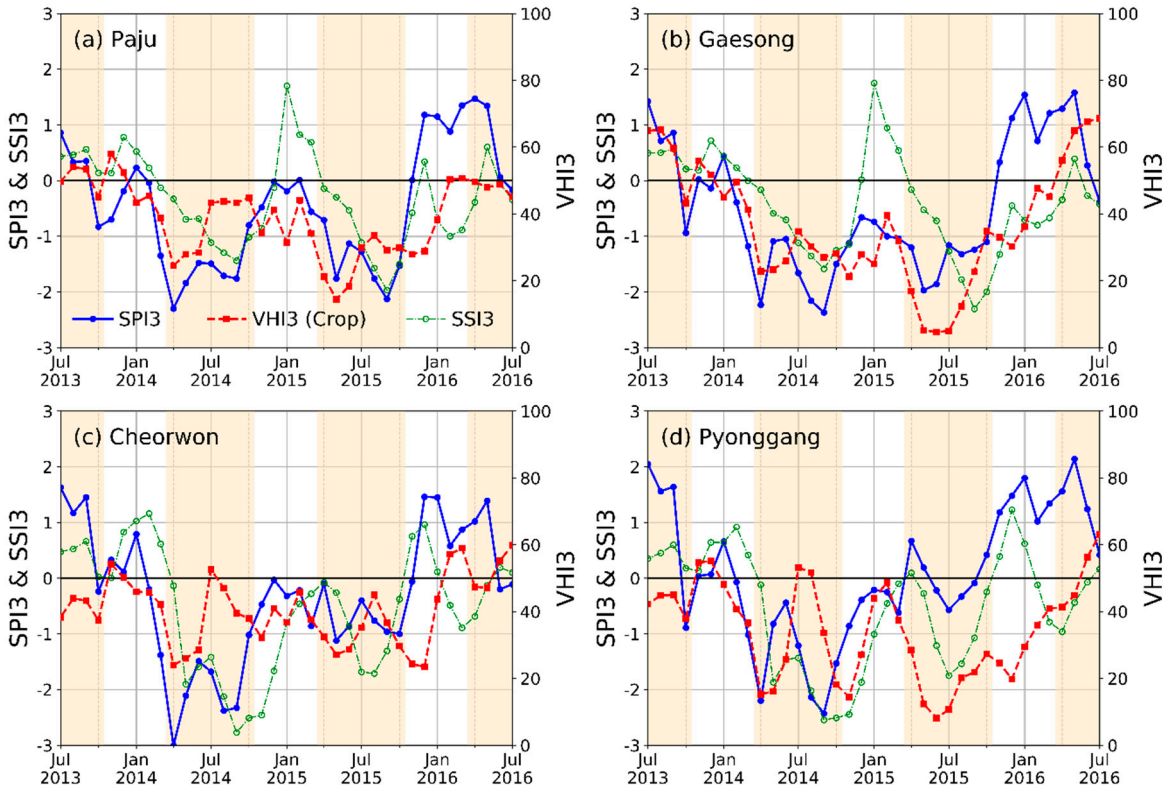


**Figure S1.** Time series of SPI3, SSI3, and VHI3 from July 2013 to June 2016, which included the drought years (2014–2015). Blue, green, red plots indicate SPI3, SSI3, and VHI3. Moccasin color means growing season (April–October) in Korean Peninsula.

Figure S1 is a time series including a 3-month standardized soil moisture index (SSI3) as well as a 3-month standardized precipitation index (SPI3) and a 3-month vegetation health index (VHI3). The SSI3 was calculated using the mean and standard deviation of 3-month soil moisture (0-10 cm) data from the GLDAS (Global Land Data Assimilation System)/Noah model for the period 2003 to 2017. In this study, we did not distinguish clearly between the land type and administrative boundaries because the spatial resolution of soil moisture data is 0.25 degrees. This study focused on the drought response in croplands. Thus, the time series of soil moisture, which were extracted based on the positions of the weather stations in each county, have been used as supplementary results.

In 2014 and 2015, the extremely dry conditions were expressed using the SSI3. The SSI3 sharply decreased during the growing season in 2014 and 2015. In Paju (Gaesong), the minimum values of the SSI3 in 2014 and 2015 were -1.44 and -1.97 (-1.59 and -2.31), which represent moderate and severe (severe and extreme) drought conditions, respectively. In Paju and Gaesong counties, the SSI3s in 2015 were lower than those in 2014. On the other hand, in Cheorwon and Pyonggang counties, the SSI3s in 2014 were lower than those in 2015. In Cheorwon (Pyonggang), the minimum values of the SSI3 in 2014 and 2015 reached -2.54 and -1.71 (-2.55 and -1.75), which indicate extreme and severe (extreme and severe) drought conditions, respectively.

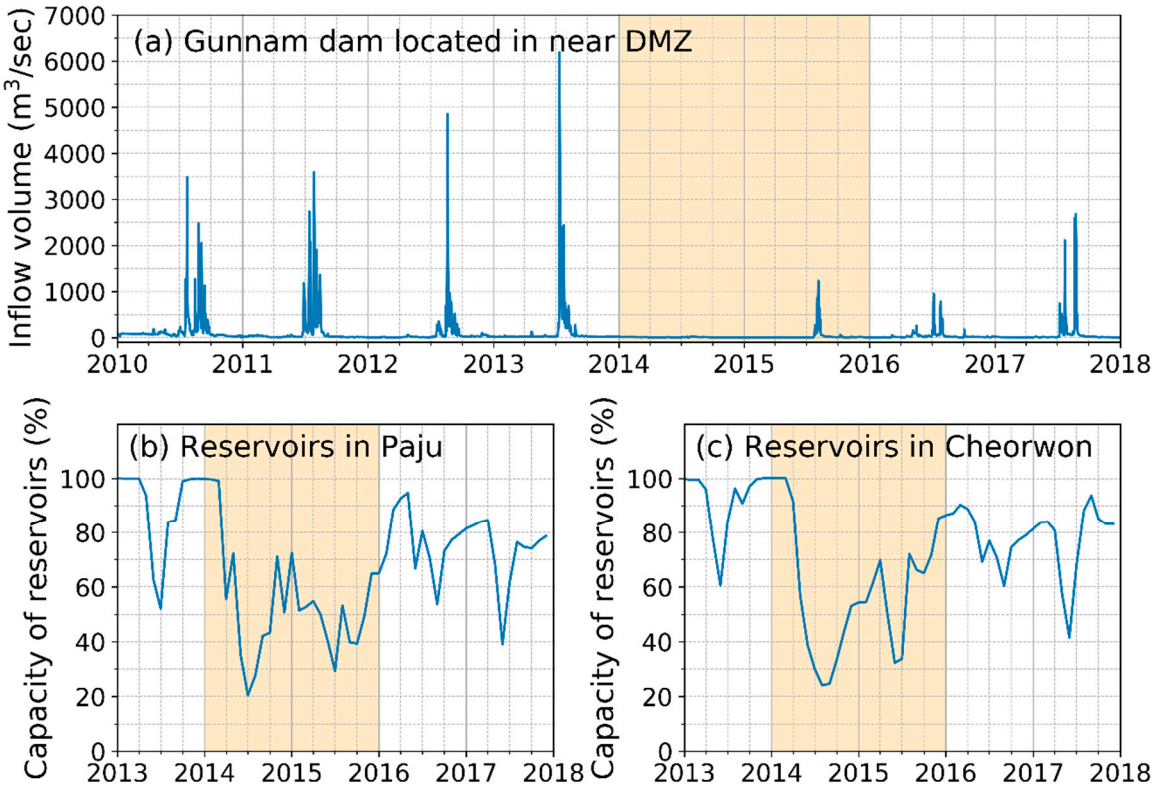


**Figure S2.** Time series of hydrological variables. (a) Inflow volume in Gunnam Dam located near DMZ, (b) Capacity of reservoirs in Paju, (c) Capacity of reservoirs in Cheorwon.

Figure S2 shows a time series of hydrological variables, such as inflow volume and capacity of reservoirs, which represent water use in cropland directly and/or indirectly. Gunnam Dam is located near DMZ, and the Imjin River related to Gunnam Dam is a shared river from North Korea to South Korea. Upstream of the Imjin River is located in North Korea. The Gunnam Dam was constructed for a special purpose, that is, to prevent water from flowing from North Korea, so it controls flood in South Korea. Thus, the inflow volume ($m^3/s$) indicates the amount of water released from North Korea. The trend of inflow volume in the drought years (2014–2015) is different from that in the non-drought years (Figure S2(a)). Figure S2(b), (c) shows a time series of reservoir capacity in Paju and Cheorwon, which decreases with the growing season (April to October) and then increases with the winter season.

**Table S1.** Yield of rice and maize in South and North Korea from 2013 to 2017

| Year | Rice | | | |
|---|---|---|---|---|
| | South Korea (Measured) | | North Korea (Estimated) | |
| | Yield (kg/m²) | Annual change (%) | Yield (kg/m²) | Annual change (%) |
| 2013 | 677,000 | - | 368,000 | - |
| 2014 | 692,000 | 2.2 | 377,000 | 2.4 |
| 2015 | 723,000 | 4.5 | 352,000 | -6.6 |
| 2016 | 723,000 | 0.0 | 389,000 | 10.5 |
| 2017 | 701,000 | -3.0 | 384,000 | -1.3 |
| **Year** | **Maize** | | | |
| | South Korea (Measured) | | North Korea (Estimated) | |
| | Yield (kg/m²) | Annual change (%) | Yield (kg/m²) | Annual change (%) |
| 2013 | 506,000 | - | 248,000 | - |
| 2014 | 518,000 | 2.4 | 250,000 | 0.8 |
| 2015 | 510,000 | -1.5 | 231,000 | -7.6 |
| 2016 | 485,000 | -4.9 | 239,000 | 3.5 |
| 2017 | 482,000 | -0.6 | 246,000 | 2.9 |

Table S1 shows the yields of rice and maize in South and North Korea from 2013 to 2017. These statistic data are analyzed from the RDA of South Korea. RDA cultivates major crops such as rice and maize depending on the cultivation conditions of North Korea to estimate the yield, because it is difficult to know the statistical data related to crop yield in North Korea. The yield of rice and maize is expressed as kg/m² because the cultivation acreage in South Korea has been decreased. The cultivation acreage is fixed as 5,710 km² (rice) and 7,110 km² (maize) when the yield per cultivation acreage of rice and maize in North Korea is estimated.