Assessment and Validation of Rice Yield and Irrigation Water Demand in South Korea based on the EPIC Model

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Abstract

Food shortage has become a serious issue related to agricultural drought in Korea. This study aimed to assess the Environmental Policy Integrated Climate (EPIC) model's suitability for the Korean peninsula and to validate its predicted results using rice paddy irrigation water demand and yield as case studies. The study area covered 10,018,810 ha of rice paddies in South Korea. The model parameters were adjusted based on South Korea's conditions, and the results were compared with national statistics to validate the model. The study found that the model could predict rice yield and irrigation water demand with reasonable accuracy, demonstrating its potential for assisting food security decisions in Korea.

Introduction

In 2019, the Food and Agriculture Organization (FAO) announced that North Korea was a severe food shortage country, and this is closely related to agricultural drought frequency. In terms of climate change, agricultural drought is not just a national problem but a global scale issue. Various crop model studies respond to agricultural drought-related food shortage by conducting local and global access to public data. In this study, the rice yield and irrigation water demand in South Korea were estimated as a pilot study to verify the Environmental Policy Integrated Climate (EPIC) model's suitability for the Korean peninsula.

Data and Method

Study Area

- Korean Peninsula is divided by South and North
- South Korea is 10,018,810 ha (33°06'43"N/131°52'0"E)

Data

- Climate data
  - Daily temperature (min, max), windspeed, precipitation, solar radiation, humidity were required
  - Daily climate data in 2018 was provided by Korea Meteorological Administration (KMA)
- Soil data
  - Soil data was provided by FAO and which is called FAO Harmonized World Soil Database
- Digital Elevation Model (DEM)
  - From Korea National Geographic Information Institute

Method

- EPIC Model
  - EPIC Model is an integrated crop model developed by Texas A&M and utilized for crop monitoring and predicting in research area widely
  - Input data Preprocessing
    - EPIC Model is activated when grid input data which applied interpolation method is equipped
  - Parameter Validation
    - For accurate estimation or monitoring, the parameter must be validated suitable to the target area
    - It includes control, crop, management, weather sector
  - Estimation and Validation of Results
    - Results (crop yield and irrigation water demand) area were clipped by South Korea Rice paddy area (Jo et al., 2020)
    - The results were validated by Korea national statistics

Results and Conclusion

- About 80 parameters were adjusted suitably to South Korea such as IET, soil profile, irrigation efficiency, harvest index
- The figure for results are divided left and right and each of right side is original results and the left side is our results
- The result of rice yield shows the mean of yield per area is 4.999 t/ha and which is almost same as other research in South Korea
- The result of irrigation water demand shows the mean of irrigation water demand per area is 1000 mm
- Table 1 shows a quantitative comparison with results and national statistics

Table 1. Quantitative comparison with results and national statistics

<table>
<thead>
<tr>
<th></th>
<th>Prediction</th>
<th>National Statistics</th>
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<tbody>
<tr>
<td>Rice paddy irrigation(mm)</td>
<td>8,449,399,705</td>
<td>8,121,672,300</td>
</tr>
<tr>
<td>Rice Production(ton)</td>
<td>4,159,047</td>
<td>3,744,450</td>
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</tbody>
</table>

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Reference


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