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

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Introduction

- In 2019, The Food and Agriculture Organization(FAO) announced that North Korea was a severe food shortage country and which is closely related to the 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 with food shortage have been conducted but access and objectivity to public data in North Korea is limited
- In this study, the rice yield and irrigation water demand in South Korea were estimated as a pilot study to verifying the Environmental Policy Integrated Climate(EPIC) model's suitability aimed at the Korean peninsula.

Data and Method

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

■ Data
- **Climate data**
  - Daily Temperature(min, max), Windspeed, Precipitation, Solar radiation, Humidity were reqiured
  - 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 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)
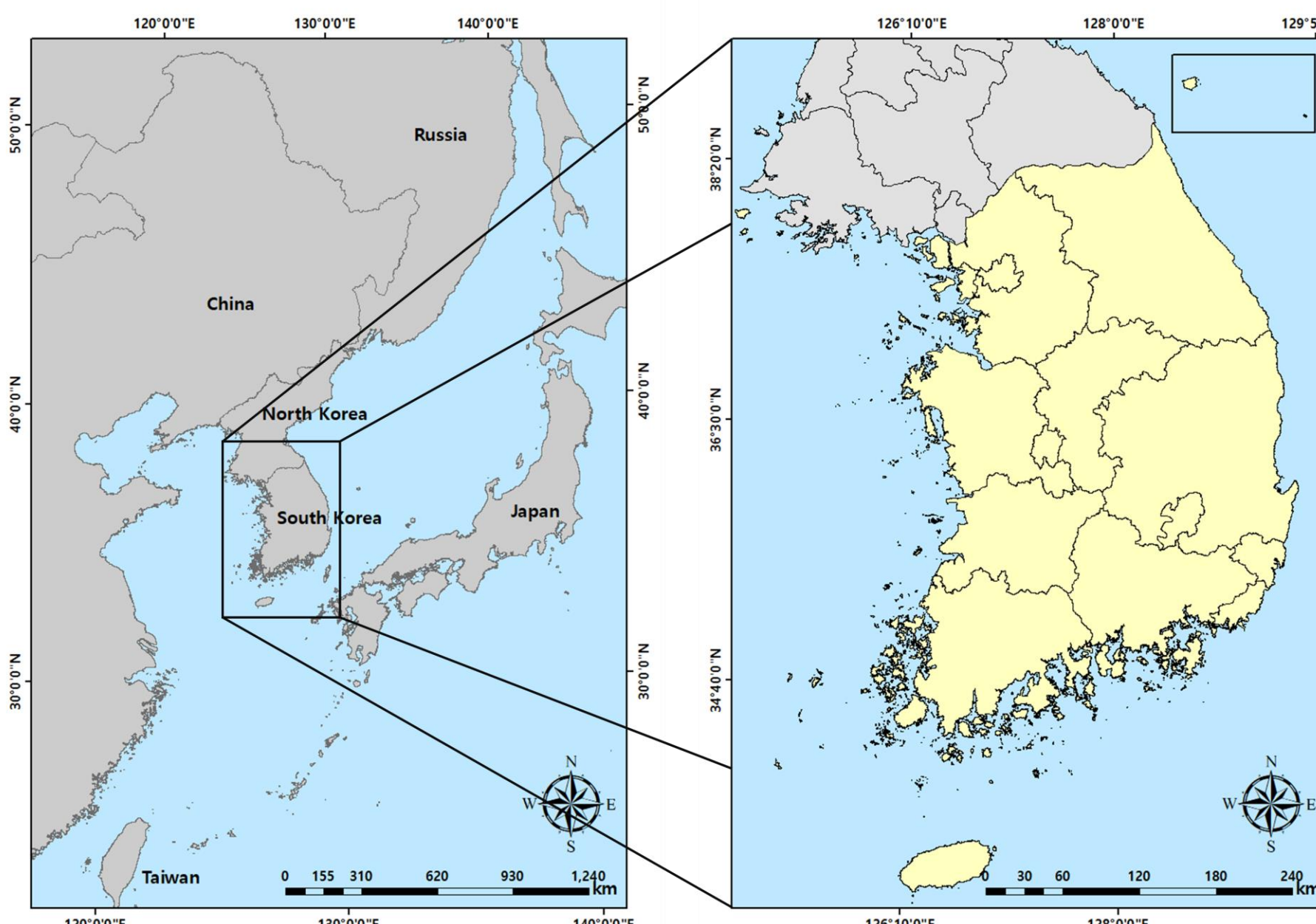 - The final results were validated by Korea national statistics

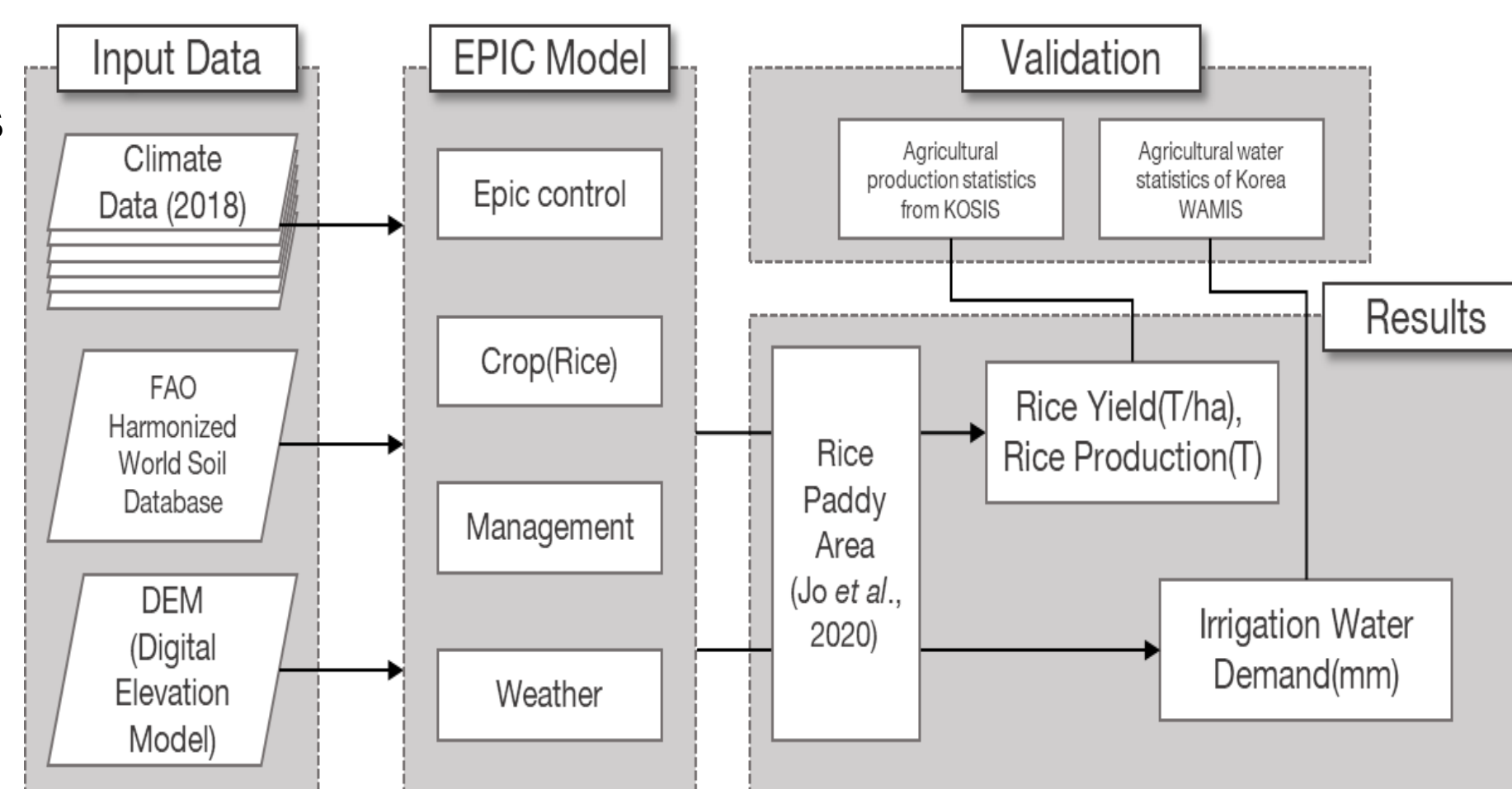Fig. 1. The Study area for applying the EPIC Model

Fig. 2. Research flow for assessing and validating of EPIC model
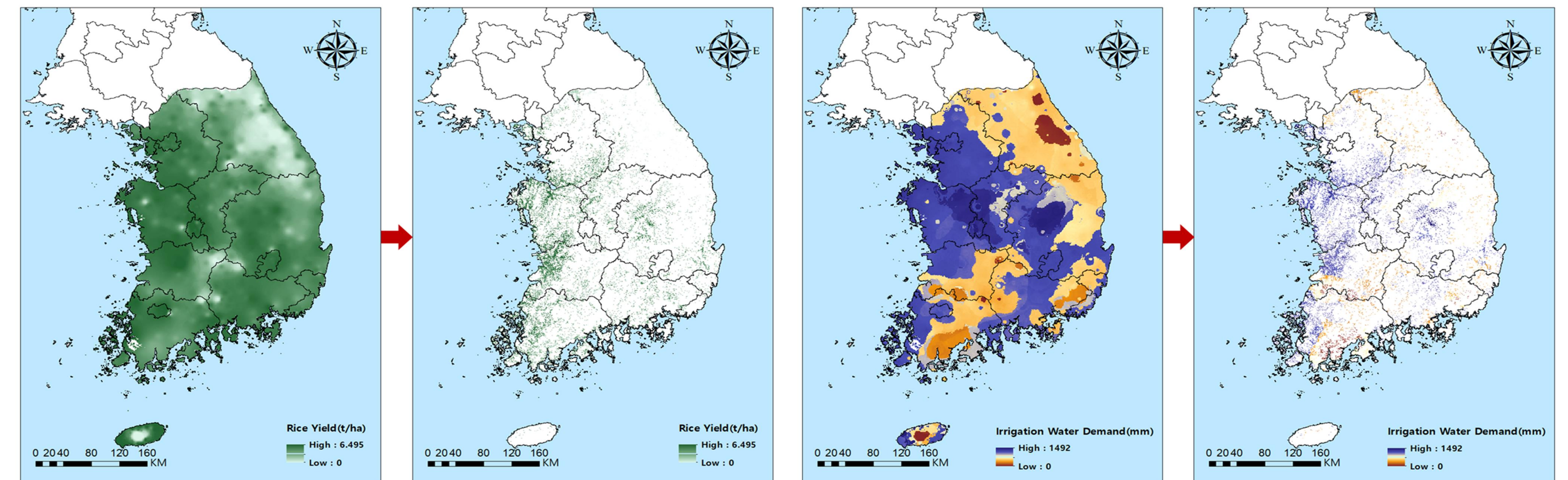
Result and Conclusion

Fig. 3. Results of Rice Yield(left), and Irrigation Water Demand(right)

- 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 zonal of rice paddy 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 1000mm
- Table 1 shows a quantitative comparison of the total amount of each result with national statistics and our results were overestimated slightly but in the case of quantitative comparison, it is significant.
- In terms of North Korean food security, this method and the adjusted parameter will be the basic study for responding to crop monitoring and food shortage
- This study is a pilot study for considering some of Korean peninsula, and the study which considering North Korea and the RCP scenario will be conducted.

Table 1. Quantitative comparison with results and national statistics

	Prediction	National Statistics
Rice paddy Irrigation(mm)	8,449,399,705	8,121,672,300
Rice Production(ton)	4,159,047	3,744,450

Reference

- Jo, H. W., Lee, S., Park, E., Lim, C. H., Song, C., Lee, H., ... & Lee, W. K. (2020). Deep Learning Applications on Multitemporal SAR (Sentinel-1) Image Classification Using Confined Labeled Data: The Case of Detecting Rice Paddy in South Korea. *IEEE Transactions on Geoscience and Remote Sensing*.

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