

CADAT 2024: AI and Machine Learning for Crops

**Crop yield estimation using
satellite images and
municipal yield statistical data**

Chisa Iwasaki, Ryo Sugiura, Mitsunori Ishihara

**Research Center for Agricultural Information Technology,
NARO**

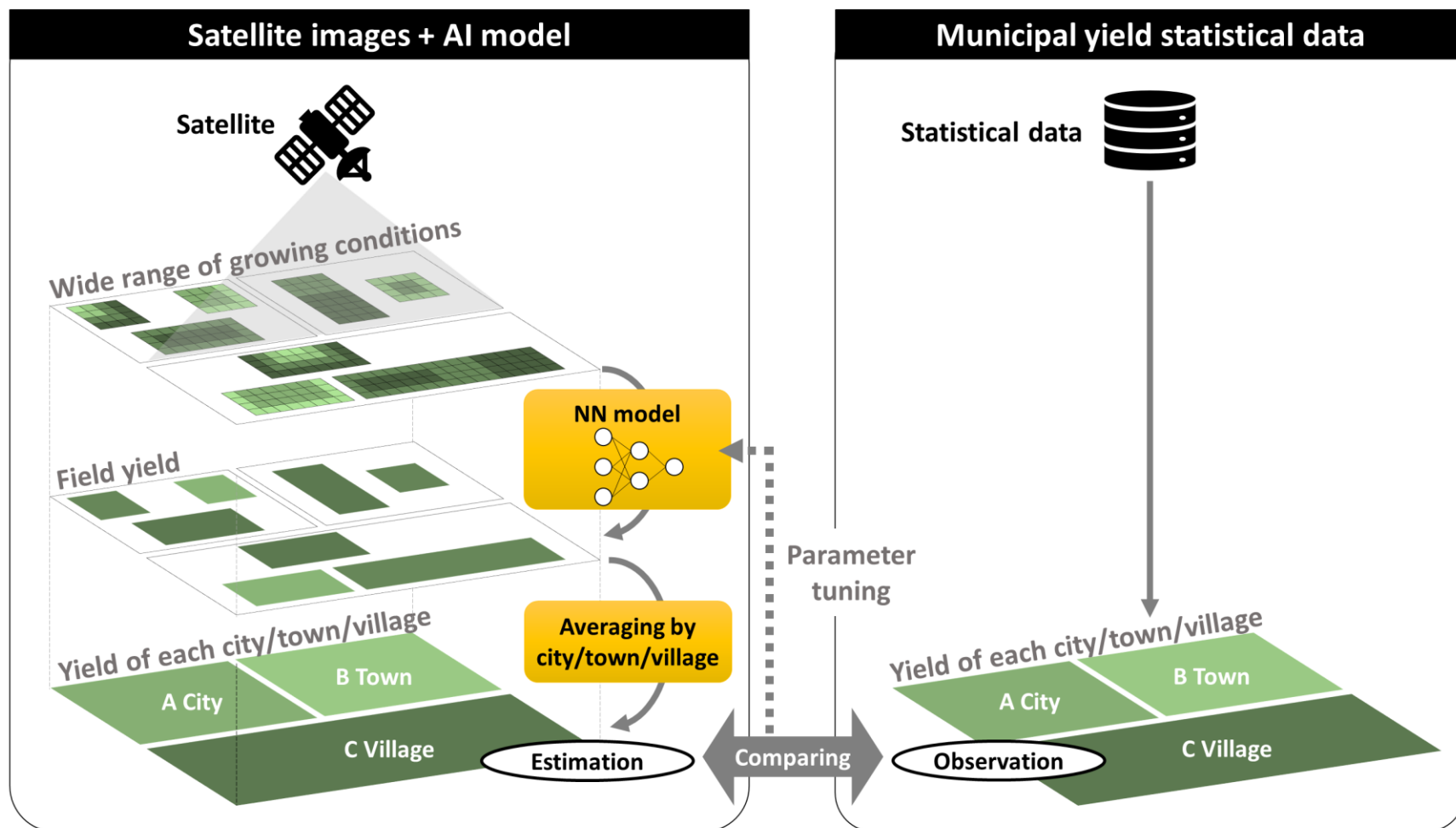
[Background]

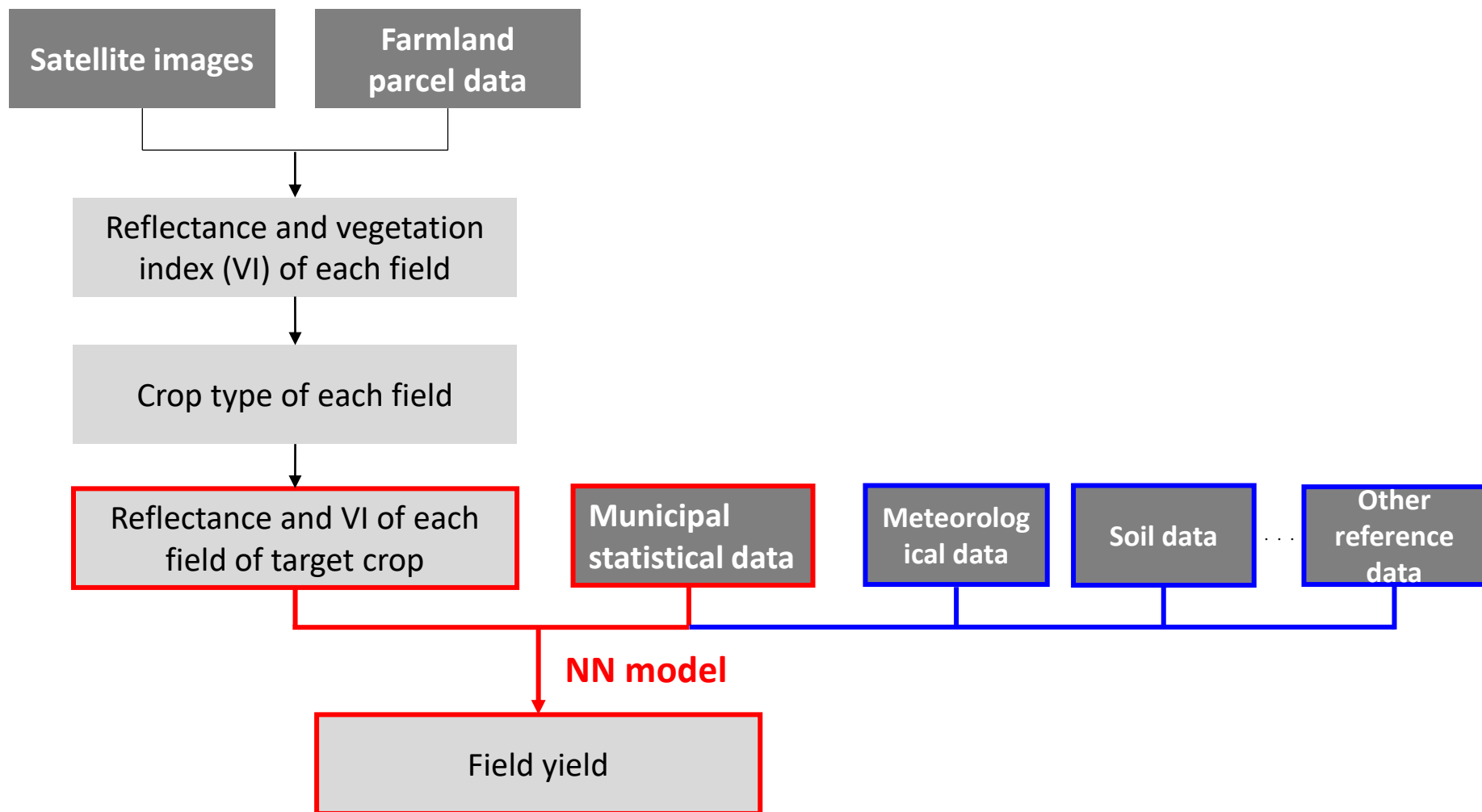
- During crop cultivation, differences in growing environments such as weather and soil, and differences in cultivation management among fields can lead to variations in final yields.
- Estimating the yield per field is useful for setting yield targets and for reviewing cultivation management used for each field.
- Methods for estimating a wide range of field yields using satellite images have been proposed through numerous studies. Nevertheless, most of the methods require many ground sampling surveys to establish models that are applicable to a wide area, which is often impractical given the effort involved.

[Purpose]

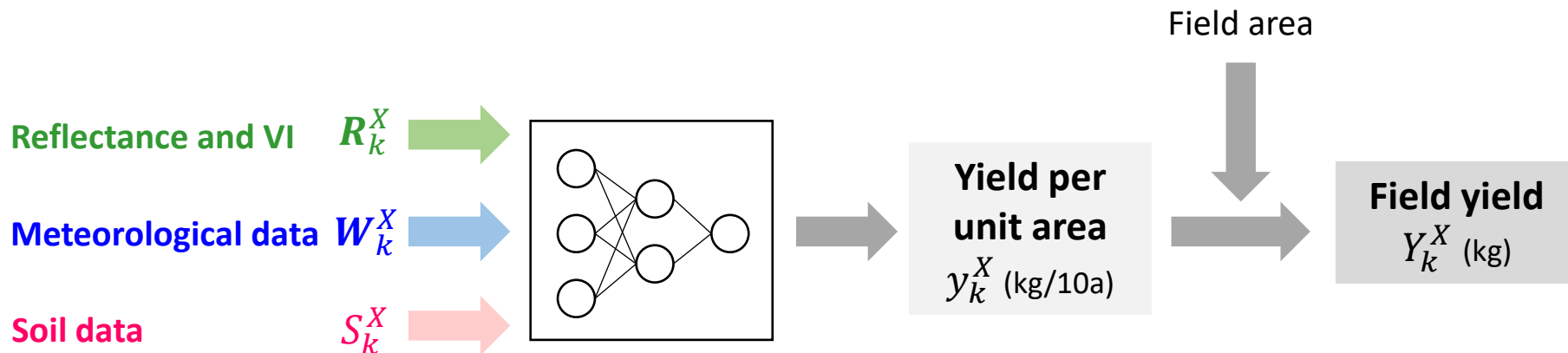
- We aim to develop a technique that requires no ground sampling survey for estimating yields at a field scale. This study was conducted to facilitate estimation of a wide range of field yields at low cost.

Field yield estimation using satellite images and municipal yield statistical data

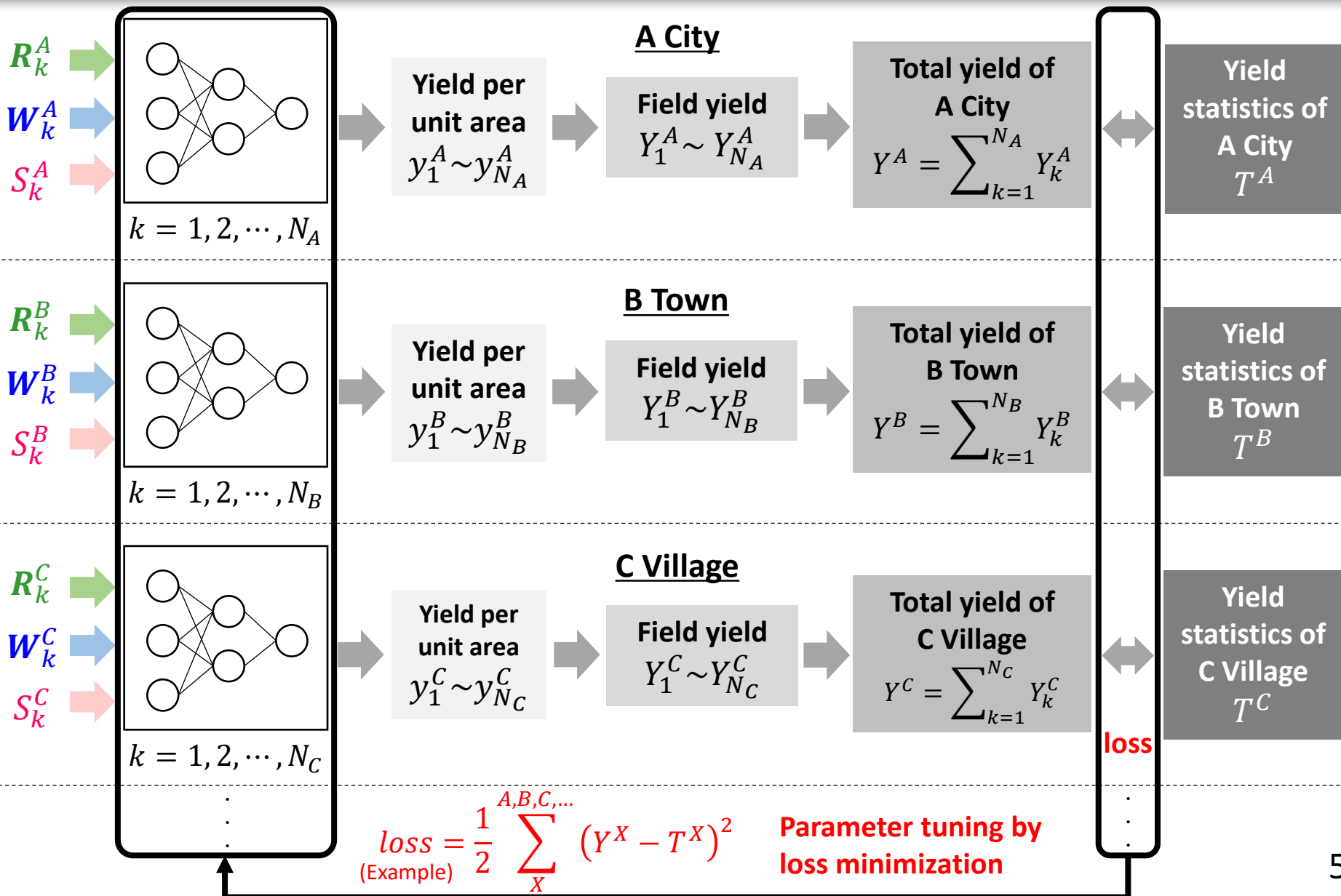




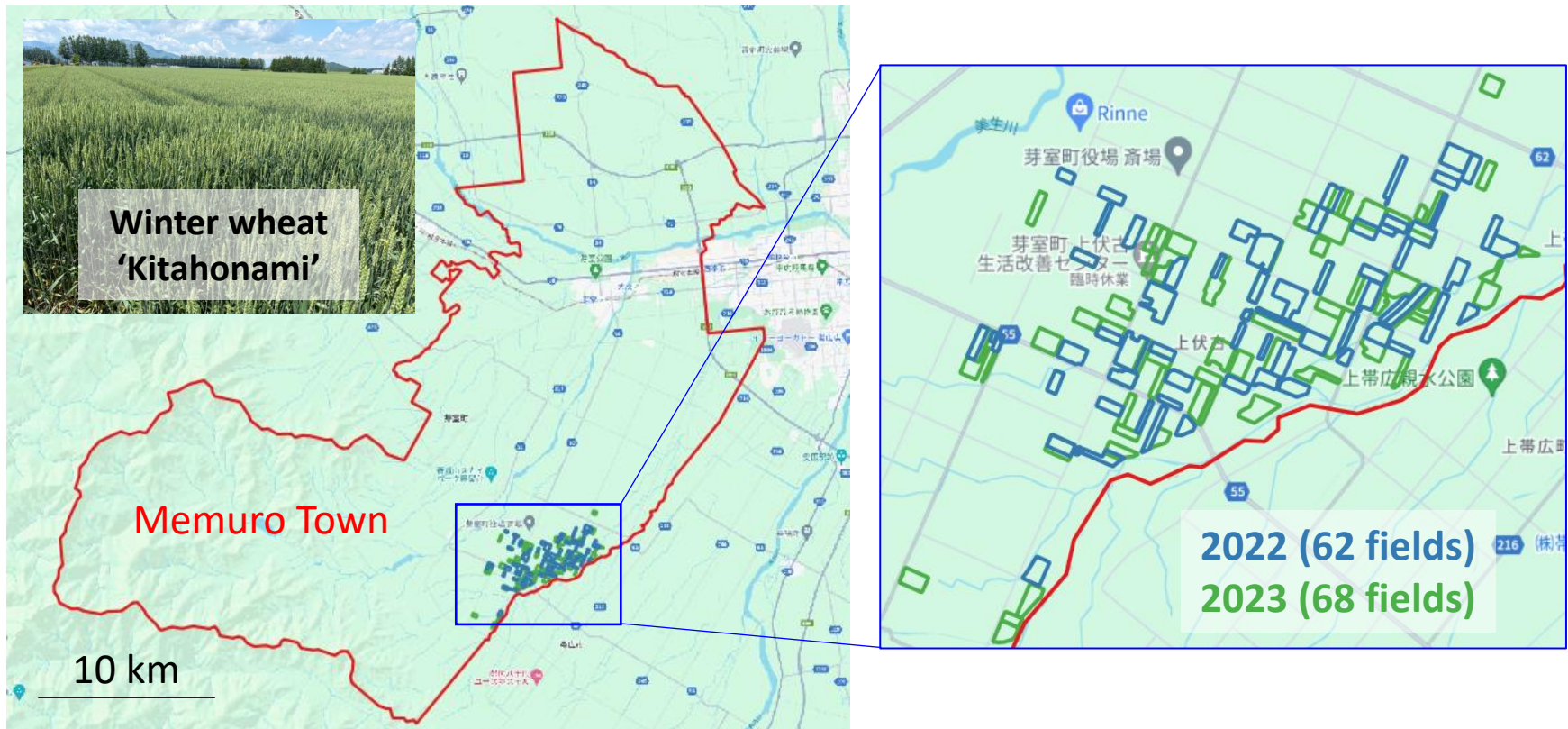
Yield estimation of k th field in X City



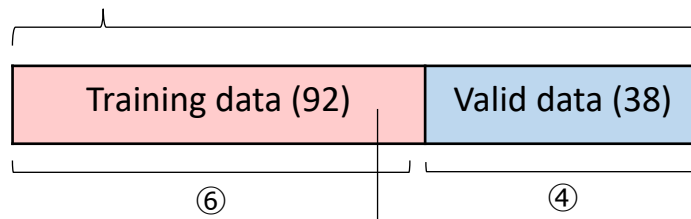
Field yield estimation of multiple cities



[Preliminary study] Yield estimation of winter wheat cultivated in Memuro Town, Hokkaido, Japan

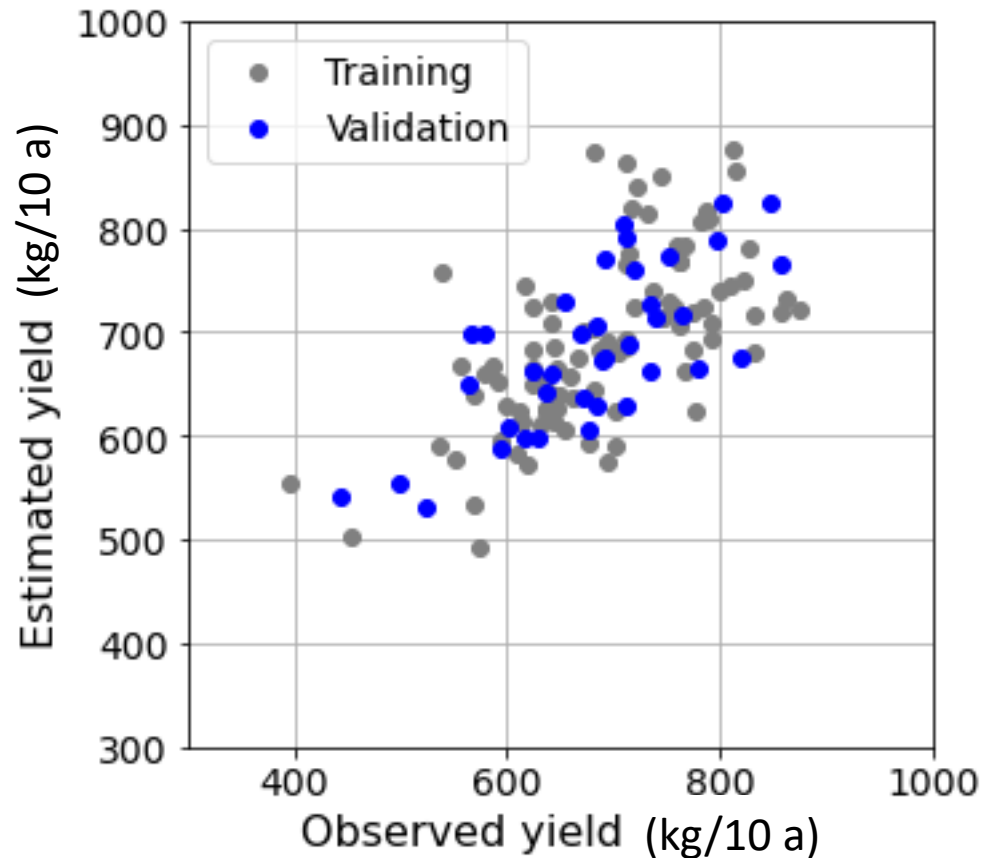


Instead of using municipal yield statistical data, we used 130 yield data from a limited area in Memuro Town.



Data are separated into five groups. Sum of the yield of each group dataset is treated as a municipal yield statistical data.

Yield estimation results



- Root mean square error (RMSE): 63.72 kg/10 a
- Mean average error (MAE): 7.65%
- Correlation coefficient: 0.73**

- We proposed a technique for estimating yield at the field level. It requires no ground sampling survey. By training the NN model using satellite images and municipal yield statistical data, we were able to reduce survey costs.
- In the preliminary study, field yields of winter wheat cultivated for Memuro Town were estimated using the proposed technique.
- The correlation coefficient between the estimated yields and the observed yields was higher than 0.7. The RMSE and MAE were also sufficiently small. The results demonstrated that the yield estimation model has a practical level of estimation accuracy.
- The estimation accuracy has only been verified for winter wheat cultivated in a certain area of Memuro Town. Therefore, verification for other areas and crops in future studies is necessary.