

Study on Retrieving the Crop Cultivation Practices Using High Resolution Satellite Data

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Abstract

Strengthening agricultural production management is a crucial measure to ensure national grain harvests. Northeast China boasts modern large-scale farms, serving as the cornerstone of the country's grain production, where real-time information on key agricultural activities, such as land preparation, planting, field management, and harvest, is vital for informed production management decisions. This study, based on multi-source remote sensing imagery, employed a random forest classification algorithm to develop a method for extracting critical farming activities in the Jiansanjiang Farm, including paddy field soaking and leveling, cultivation methods, distribution of paddy and dryland crops, autumn harvest, and post-harvest plowing in 2024. The findings reveal that paddy field soaking and leveling began in early April and were largely completed by early May, while directly sowed rice accounted for approximately 28.5% of the total rice planting area, primarily concentrated in the eastern part of the farm. Autumn harvest commenced in mid-September and was mostly finished by late October, with plowing activities continuing until November 3. This methodology provides timely and scientific data support for agricultural production management.

Introduction

Single remote sensing images can no longer meet the needs of monitoring work. In recent years, the real-time online free sharing of high-resolution satellite data has provided timely data support for the development of methods for extracting agricultural activity information based on remote sensing images. This study was conducted based on domestic Gaofen satellite data, European Sentinel satellite data, and satellite data from other sources.

Study Area and Data

Jiansanjiang Reclamation Area is located in the northeast of Heilongjiang Province, in the hinterland of the Sanjiang Plain (132°31' ~ 134°22' E, 46°49' ~ 48°12' N). The total cultivated land area reaches 776,000 hectares. The annual average grain output accounts for about 1/11 of the province and 1/100 of the whole country. It is an important commodity grain base in China.

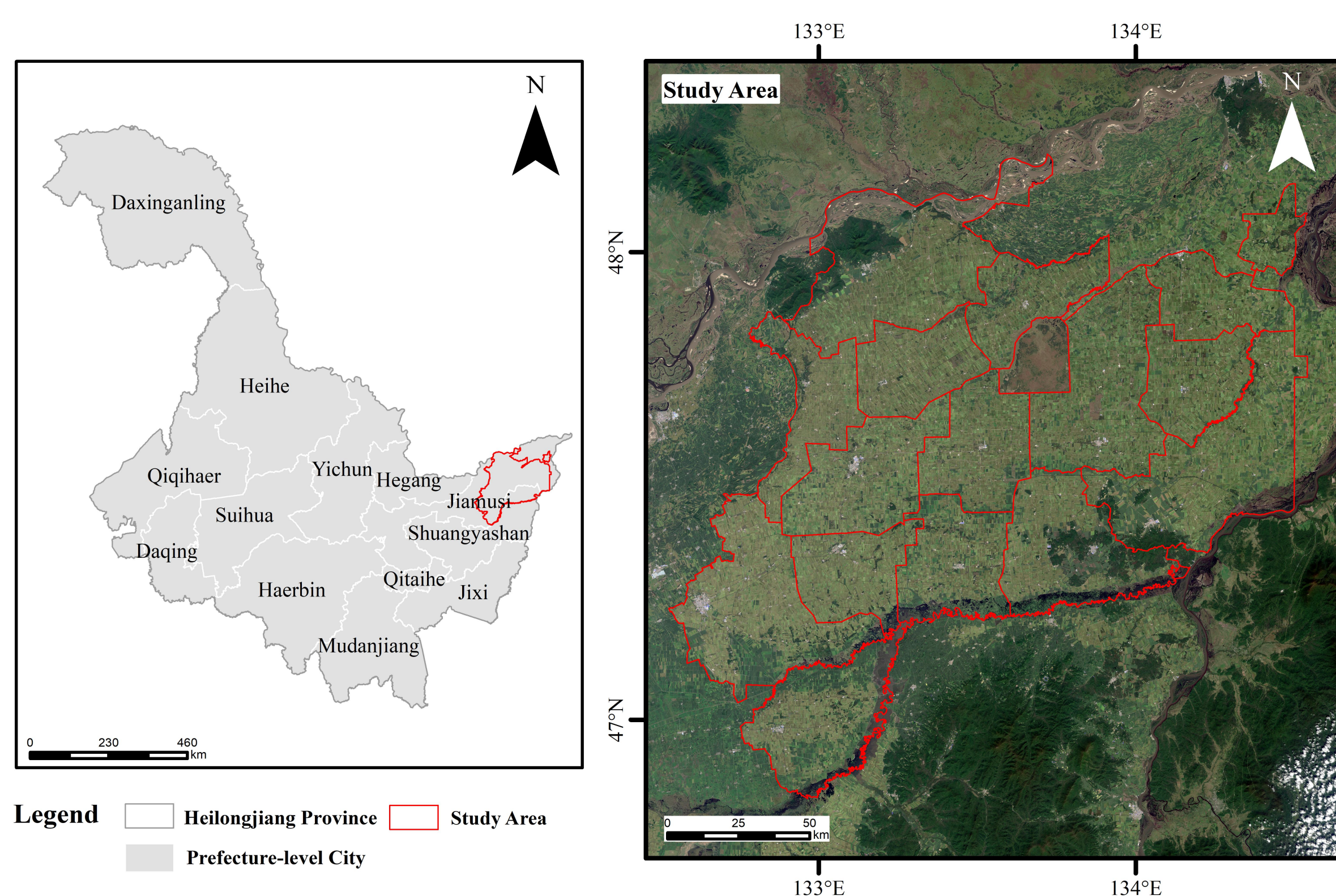


Fig.1 Study Area

In this study, HJ-2A, Sentinel-2, and Landsat-8 data in 2024 were used. The HJ-2A data were downloaded from the official website of the China Center for Resources Satellite Data and Application. The Sentinel-2A/B data were downloaded from Copernicus Data Space Ecosystem. The Landsat 8 data were downloaded from the USGS.

Methods

This study monitored the rice field dynamics within the complete growth cycle (including field soaking, growth, harvest and tillage periods), using multi-source remote sensing data. The random forest classification model was employed with a ratio of 70% training sample and 30% validation sample to achieve accurate classification results that were evaluated by error confusion matrix.

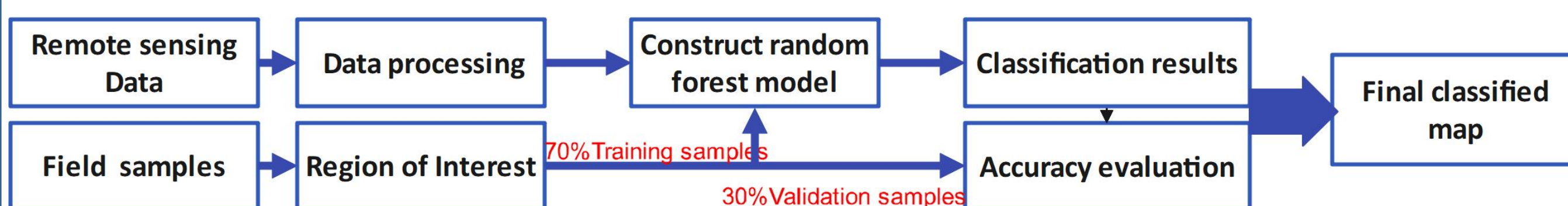


Fig.2 The technical route of this study

Results

Accuracy results of agricultural activities monitoring in four periods:

Period	Satellite	Date	Overall Accuracy(%)	Kappa(%)	F1 Score(%)
Spring Field Soaking Period	Landsat 8	2024-04-09	92.0	91.0	92.0
	S2A	2024-04-23	90.5	89.0	90.1
	Landsat 8	2024-04-25	88.0	86.0	86.1
Growth Period	S2B	2024-09-15	86.2	84.0	86.7
Harvest Period	S2B	2024-10-05	91.0	89.0	88.6
	HJ2A	2024-10-17	93.3	92.0	88.5
Autumn Field Preparation Period	S2A	2024-10-20	95.2	94.0	94.1
	Landsat8	2024-11-03	96.1	93.0	94.0

Progress monitoring results map of various agricultural activities:

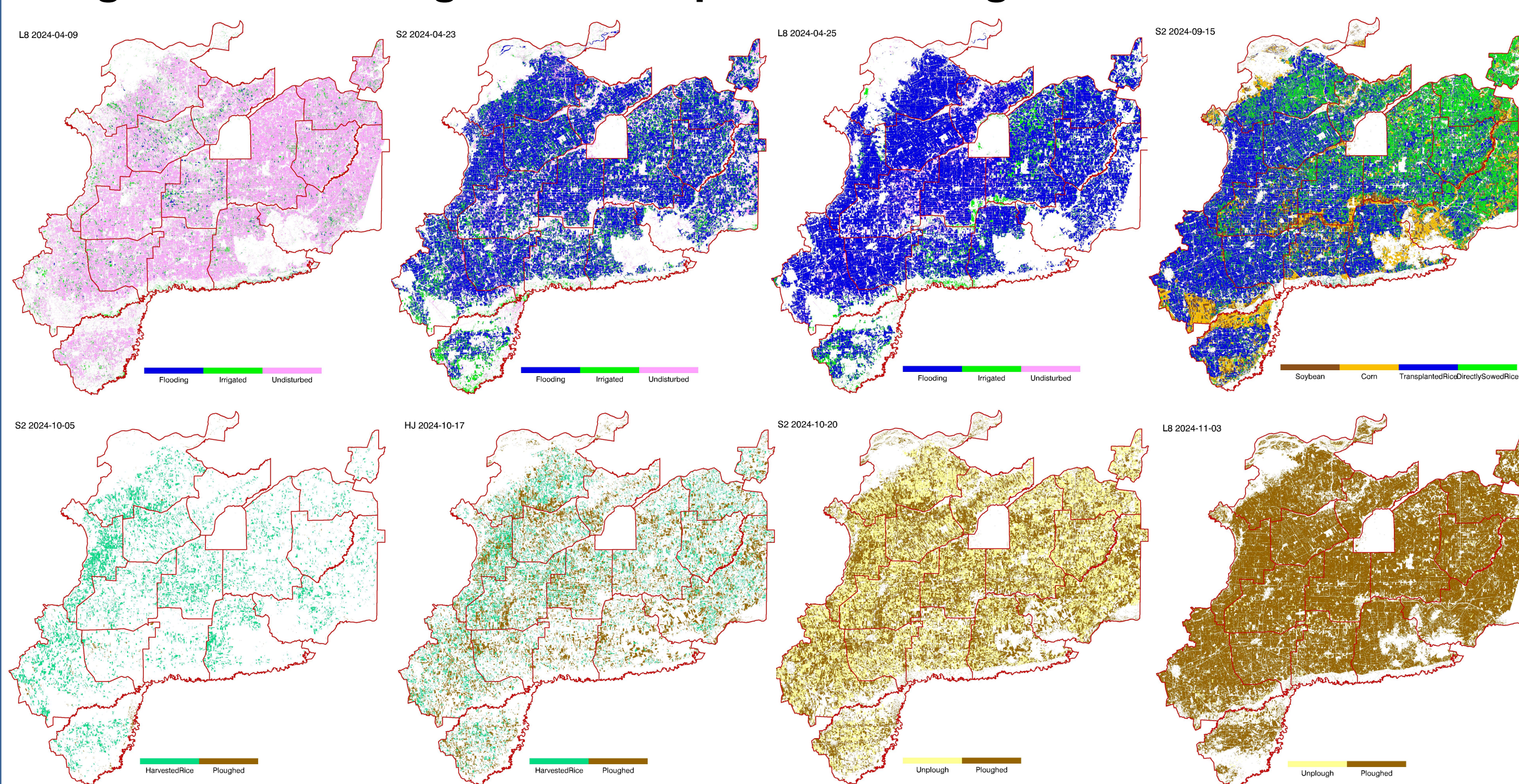


Fig.3 Monitoring results map of agricultural activities

Conclusions

The following conclusions are drawn:

1. The field soaking process started in early April 2024. As of April 25th, the proportion of preparation ready fields accounted for more than 85% of the total paddy field area, indicating the almost end of the field soaking period.
2. During the growing period, it was monitored that the planting area of directly sowed rice accounted for about 28.5% of the total rice planting area, mainly distributing in eastern farms.
3. Autumn harvest began in mid-September, and by October 20 the harvested fields had essentially covered all cultivated fields, indicating that crops were substantially harvested.
4. The plowing fields were monitored as the harvest was progressing. It found that the plowing was almost finalized by November 3, 2024.

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