NATIONAL STATISTICS OFFICE OF MONGOLIA

TWENTY-NINTH SESSION OF

THE ASIA AND PACIFIC COMMISSION ON AGRICULTURAL STATISTICS

Ulaanbaatar, Mongolia
22-25 November 2021

METHODOLOGY TO ESTIMATE CROP YIELD DATA USING REMOTE SENSING TECHNIQUES IN AGRICULTURAL STATISTICS

APCAS29

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– Chairman
NSO, Mongolia

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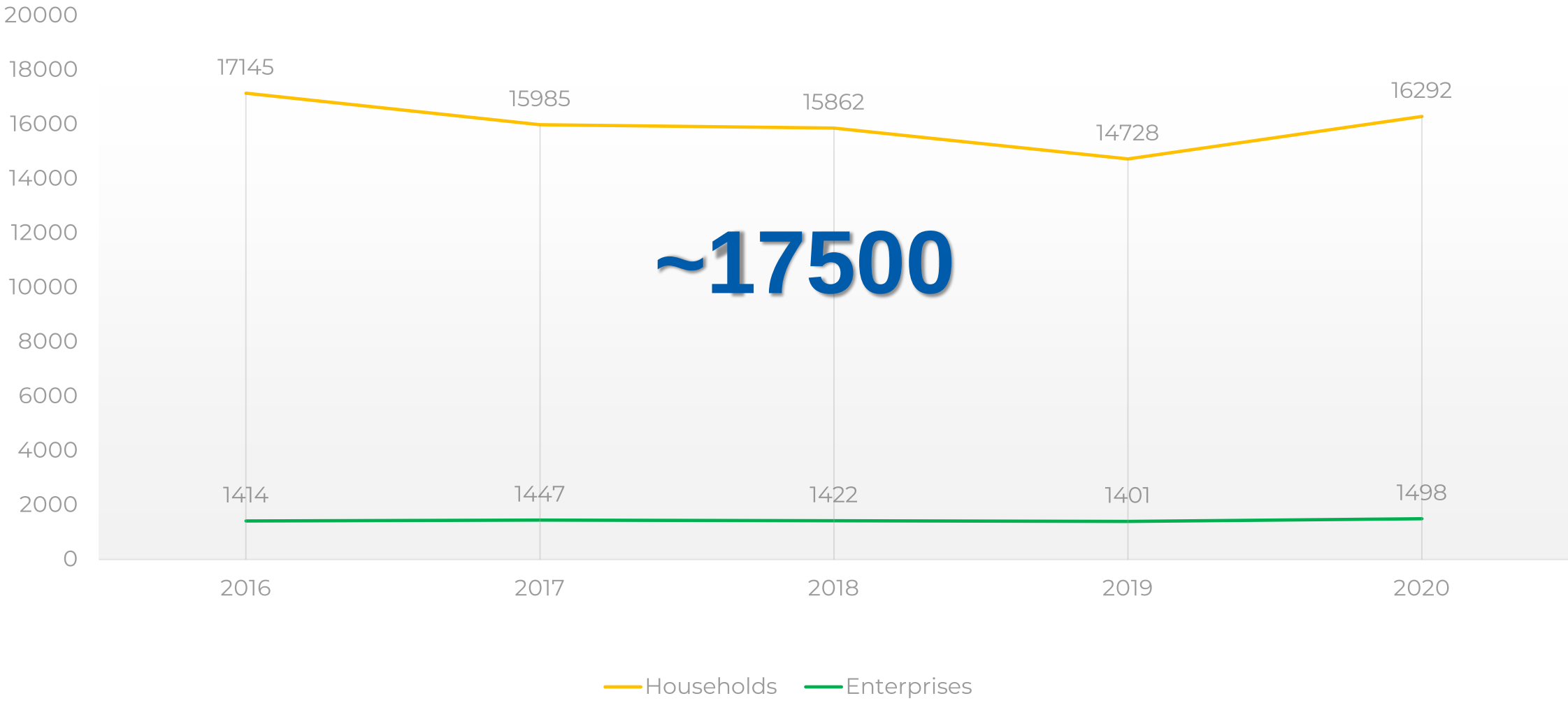
INTRODUCTION

METHOLOGY

- Random Forest
- Sample Angle Mapping
- Comparison of methodologies

CONCLUSIONS

NUMBER OF FARMER



~17500

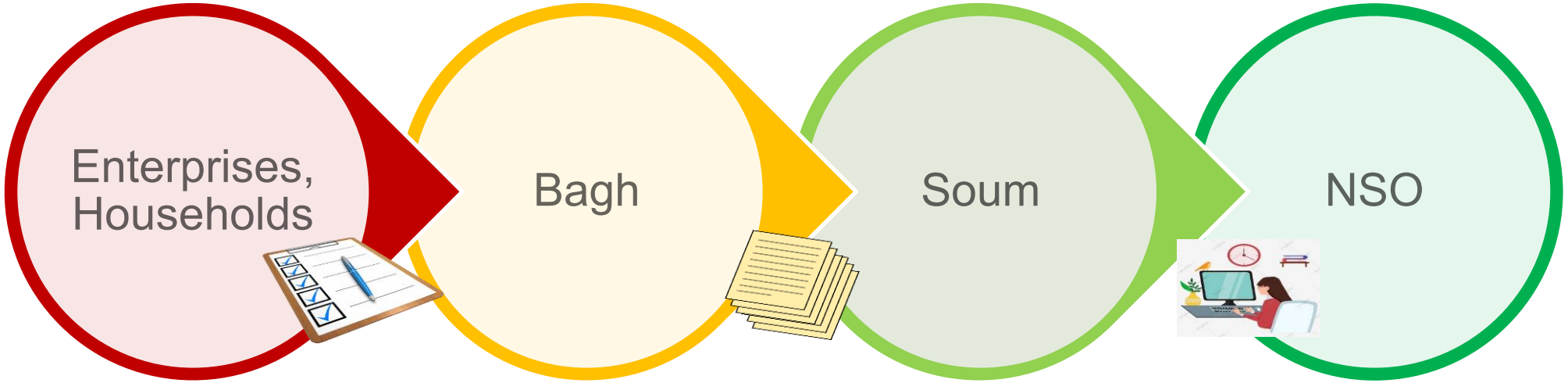
STEP OF DATA COLLECTION

17500
5 Questionnaire

1810 bagh

339 soum
100+indicators

9 times a year



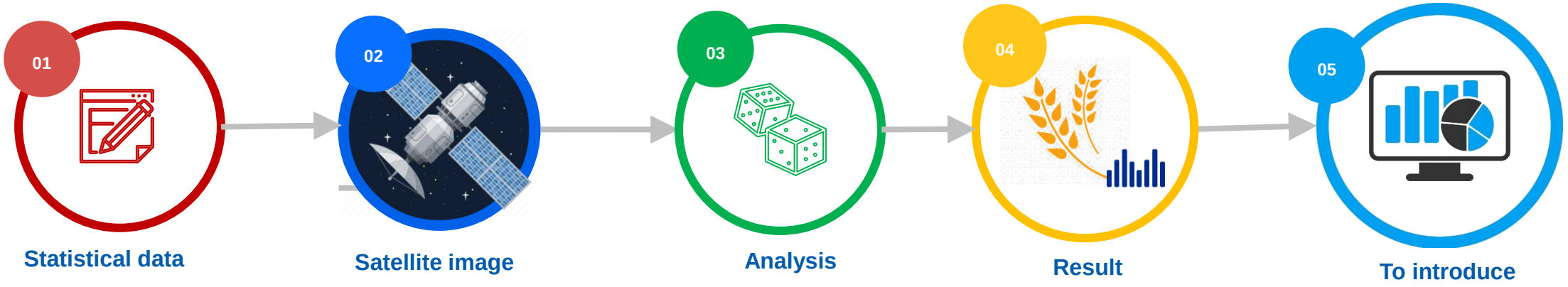
- To provide accurate information

- Questionnaire
- Deliver data to soum

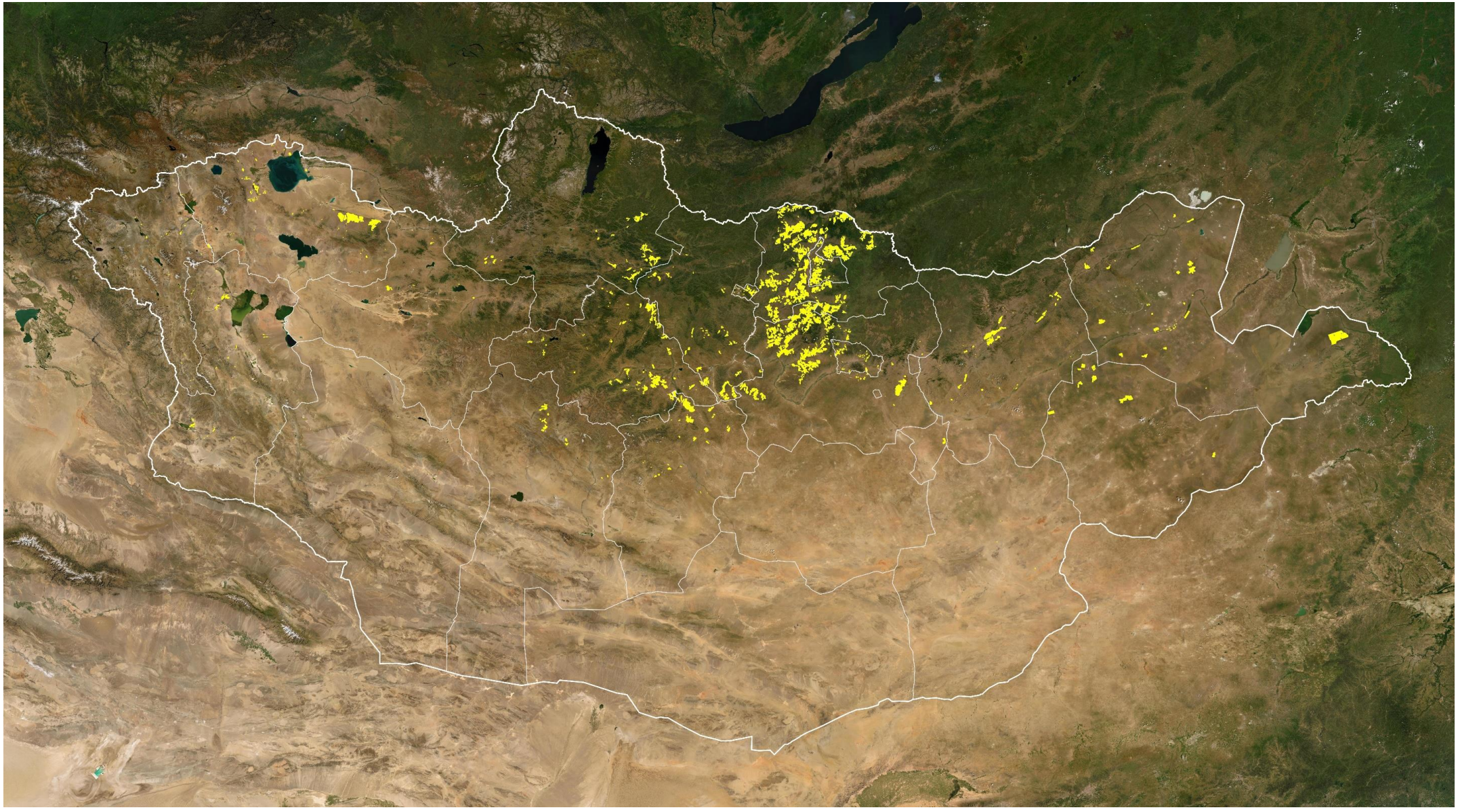
- Integrate by bagh
- To check
- Include in the program

- Integrate into the country
- To verify
- To share

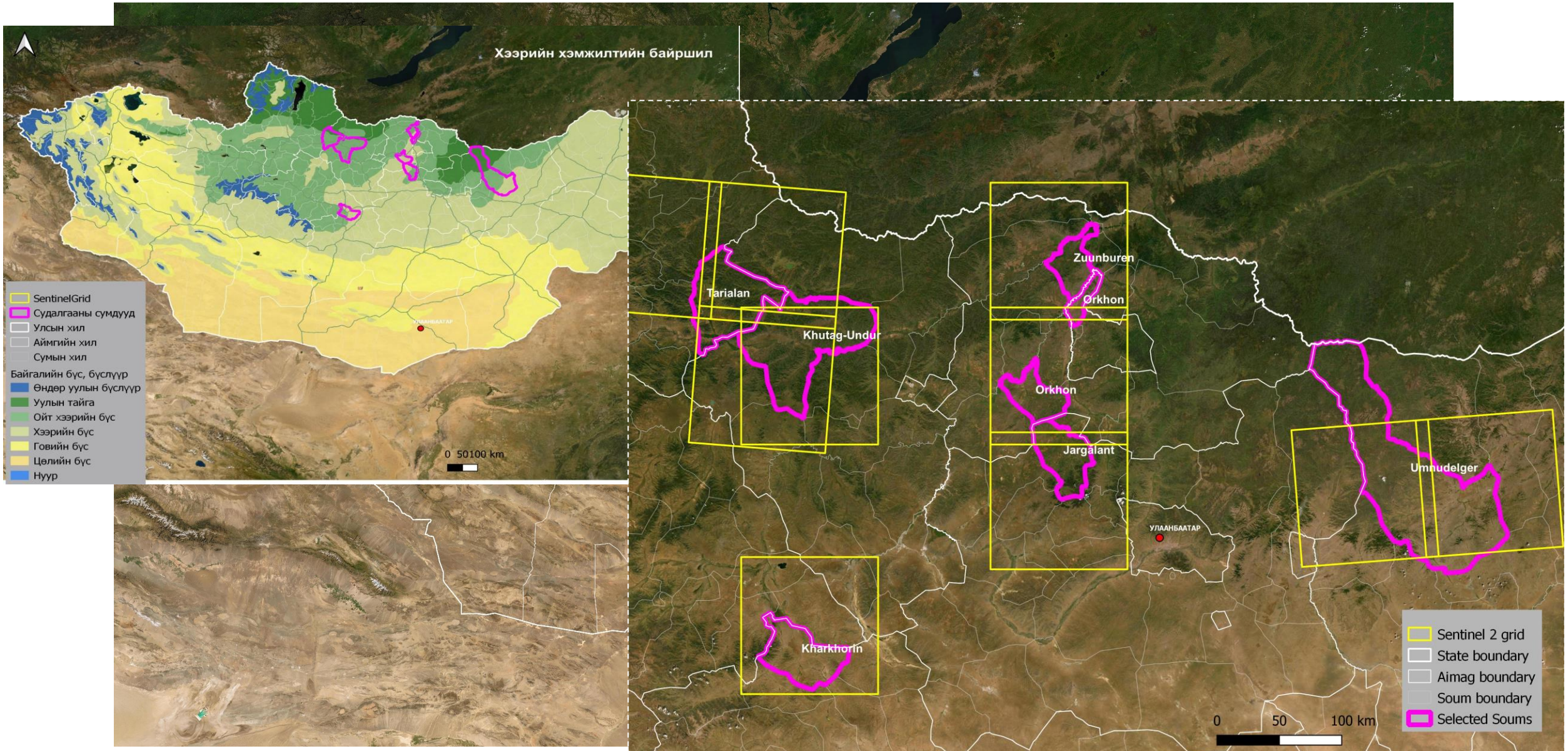
PROJECT IMPLEMENTATION PLAN AND METHODOLOGY



STUDY AREA

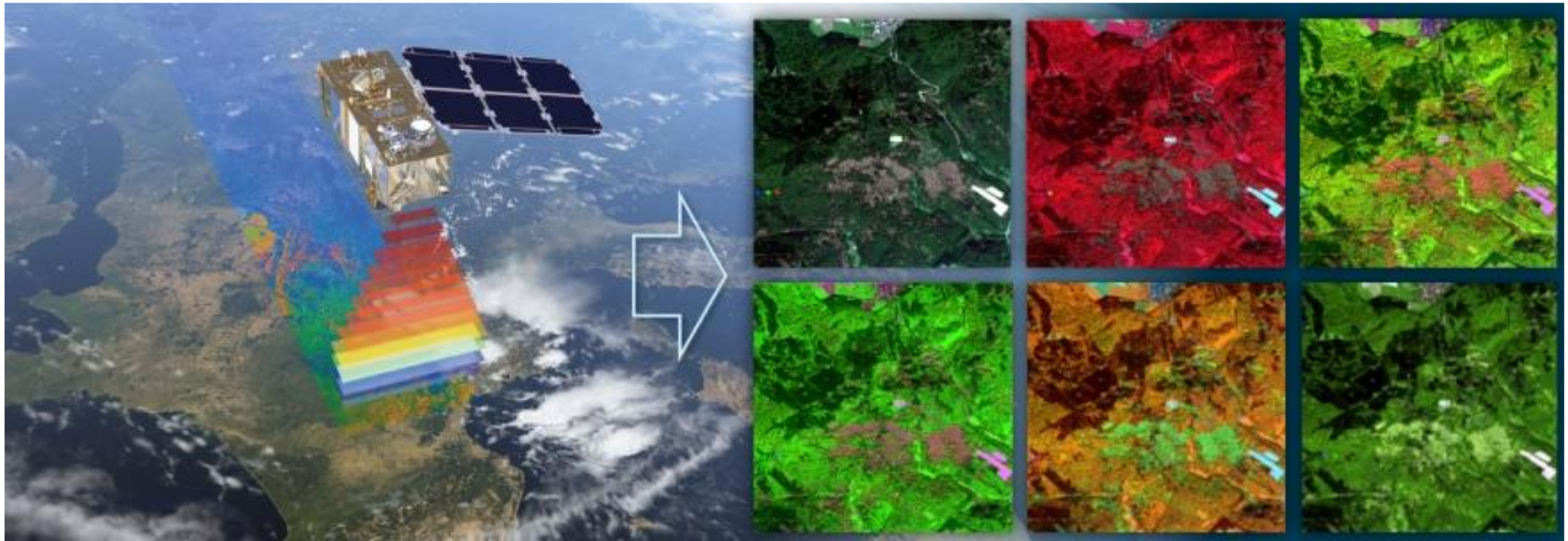


STUDY AREA


Хээрийн хэмжилтийн байршил
SentinelGrid
Судалгааны сумдууд
Улсын хил
Аймгийн хил
Сумын хил
Байгалийн бүс, бүслүүр
Өндөр уулын бүслүүр
Уулын тайга
Ойт хээрийн бүс
Хээрийн бүс
Говийн бүс
Цөлийн бүс
Нуур
0 50100 km
Tarialan
Khutag-Undur
Zuunburen
Orkhon
Orkhon
Jargalant
Umnudelger
Kharkhorin
УЛААНБААТАР
Sentinel 2 grid
State boundary
Aimag boundary
Soum boundary
Selected Soums
0 50 100 km

SATELLITE IMAGERY – SENTINEL2

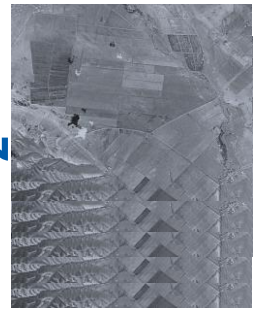
- The Sentinel-2 consists of the twin satellites 2A and 2B, high-resolution optical imagery, multi-channel spectral data
- Spatial resolution 10m, 20m, 60m
- The optical payload it carries has visible, near-infrared, and infrared sensors, which provide a total of 13 spectral bands.
- Temporal resolution – 5 days



METHODOLOGY #1. RANDOM FOREST

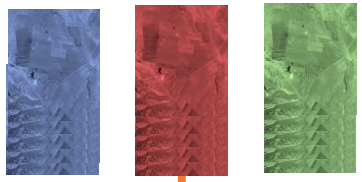
Sentinel 2

1. Atmosphere correction
2. Cloud masking

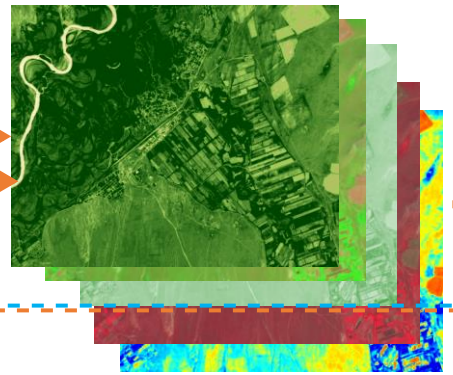


Processing

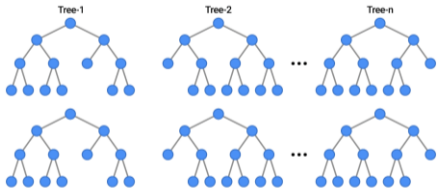
Band combination



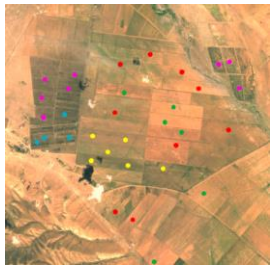
Vegetation index



Random forest Classification



Samples

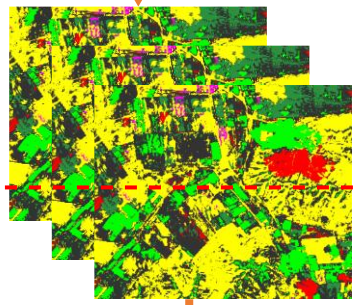


Samples on crop type

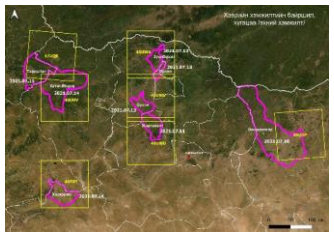
Training samples

Test samples

Accuracy assessment



Field measurement



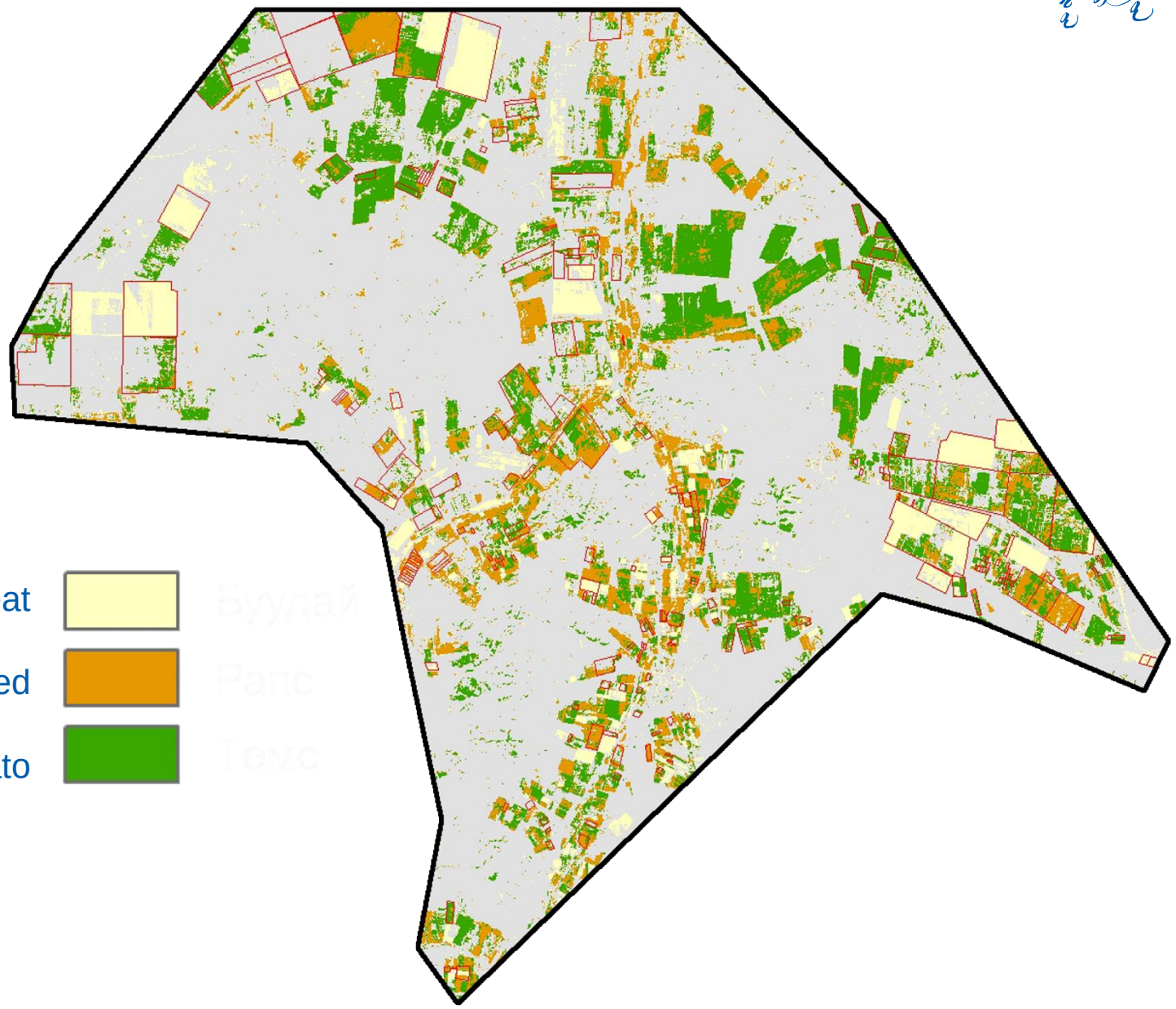
Processing

Map of arable land

RESULT

Overall accuracy - 76.92 %

kappa coefficient - 63.2%



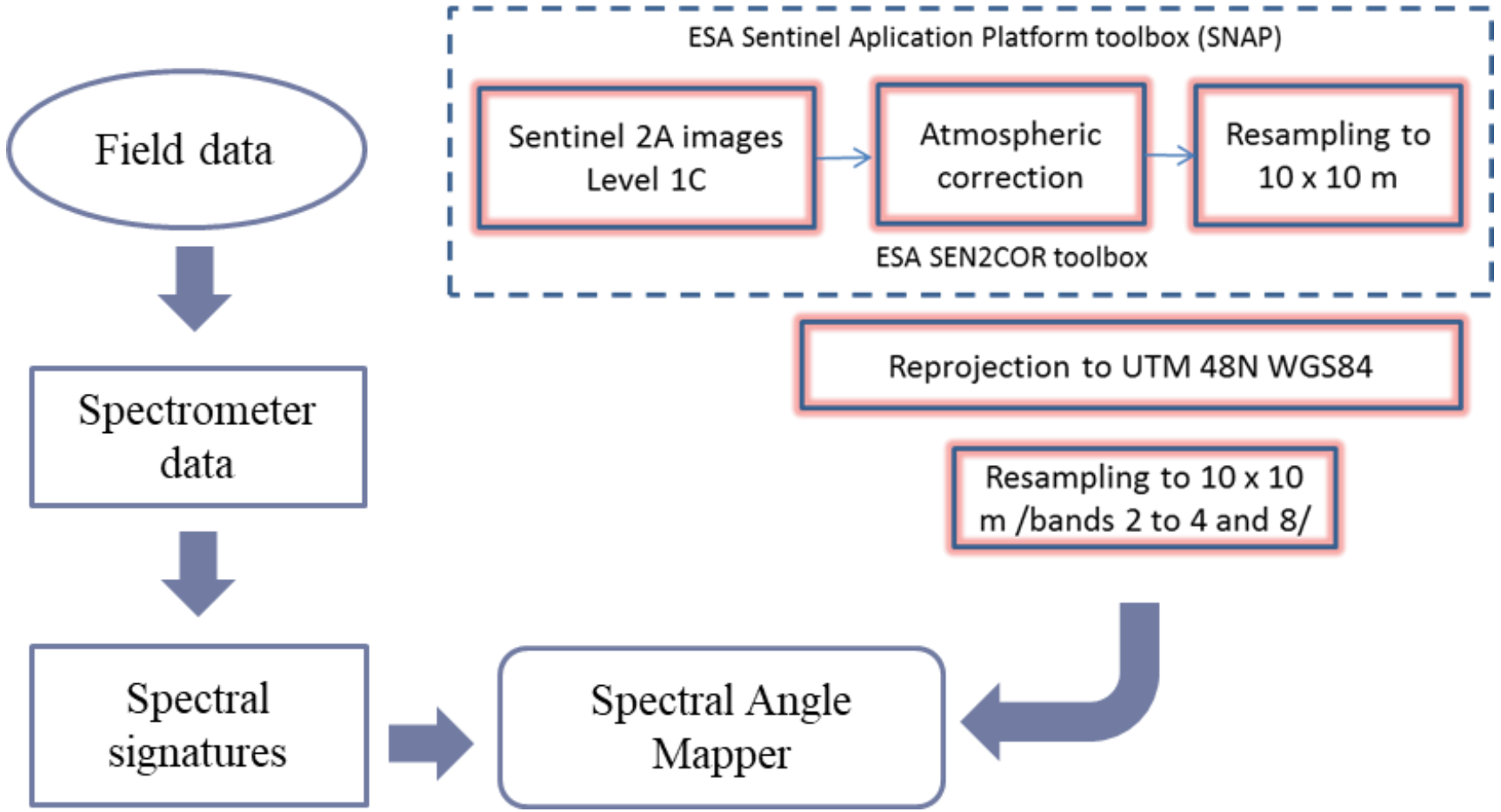
CHALLENGES

- In random forest methodology, it is important to identify the sample and correctly identify the type of crop. There was a lack of current records to accurately differentiate cropland by crop type during the survey.

- Satellite imagery is time-consuming to prepare and process, and a need for a dedicated server for storing and back-up or cloud-based was necessary.

- Accurate assumptions and decisions can be made, but it takes time and effort to calculate the data for each decision tree.

METHODOLOGY №2. SPECTRAL ANGLE MAPPER (SAM)



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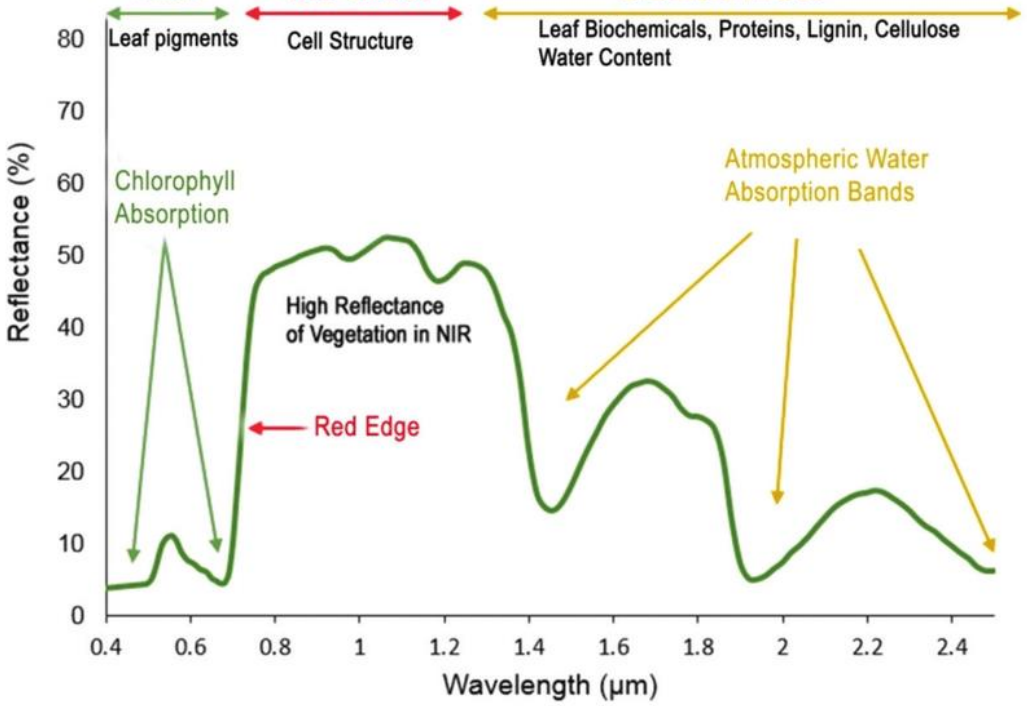
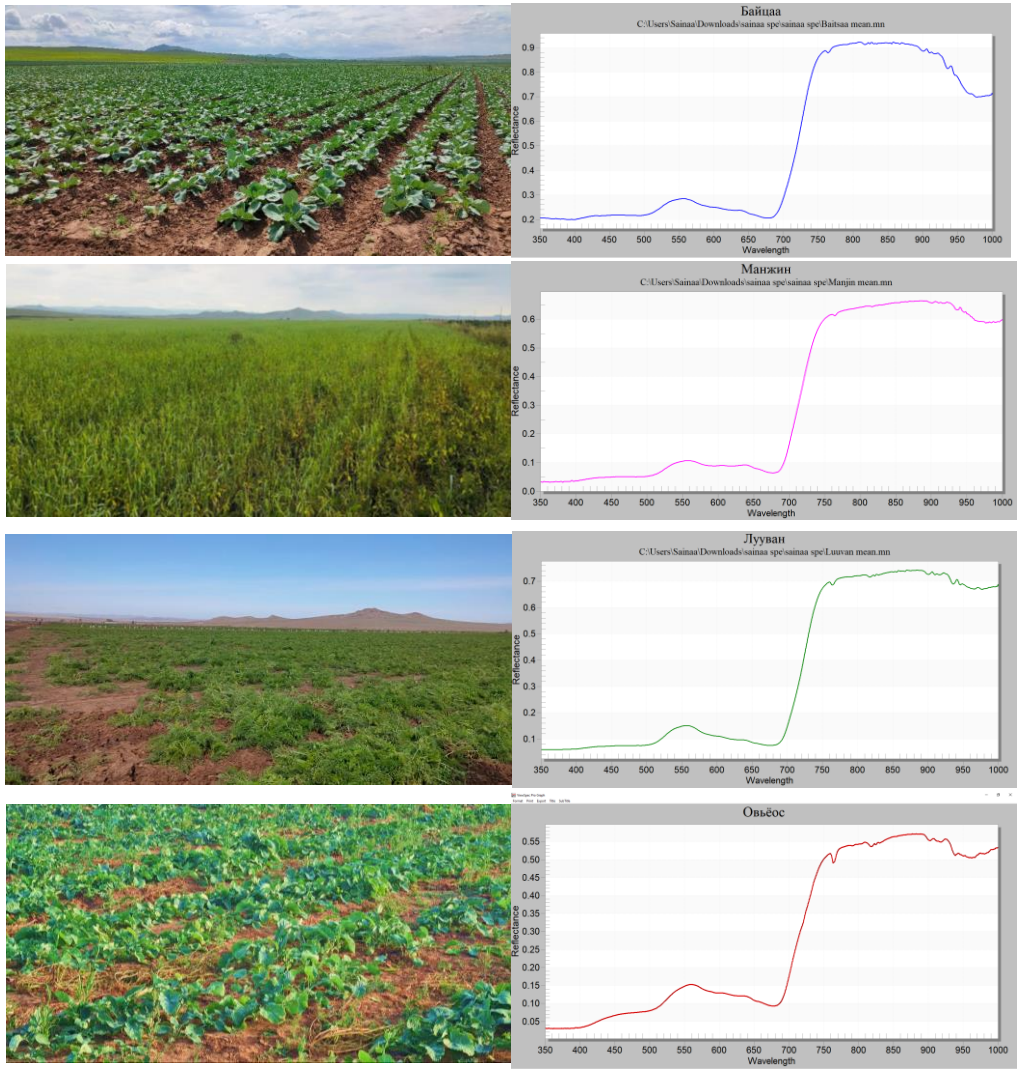
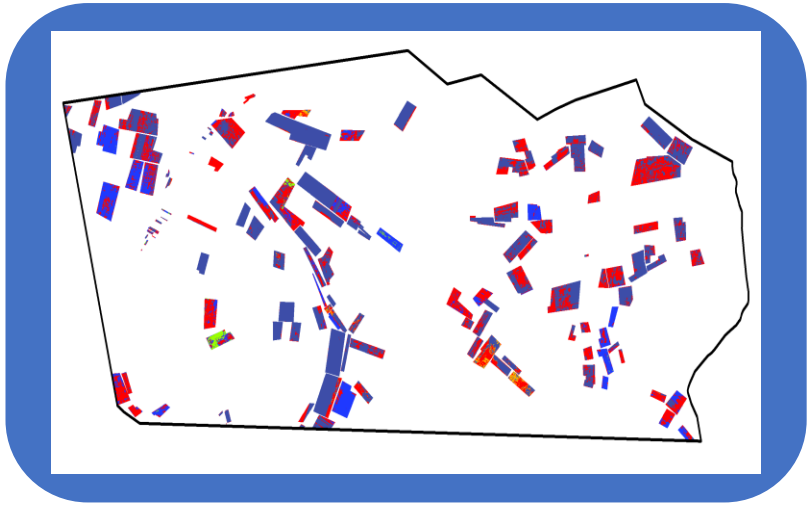


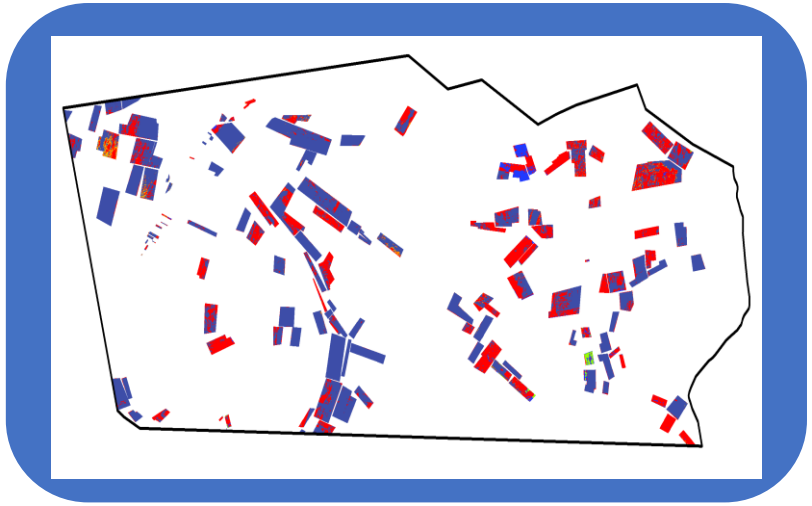


RESULTS

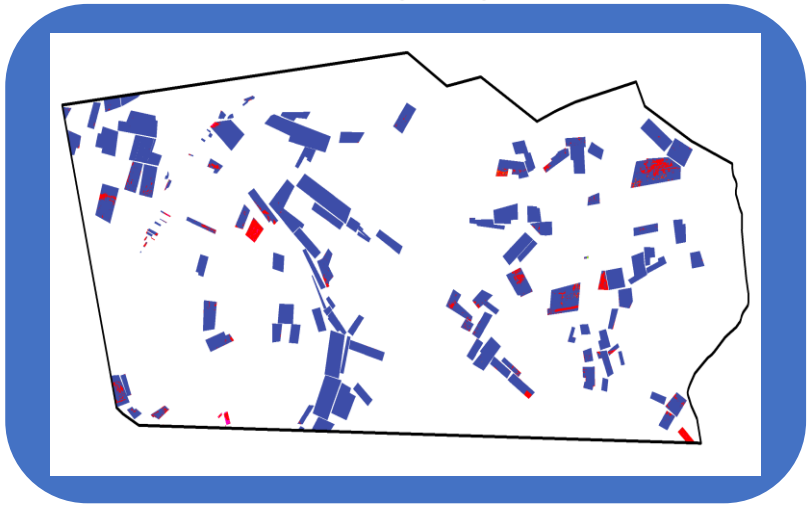
2016



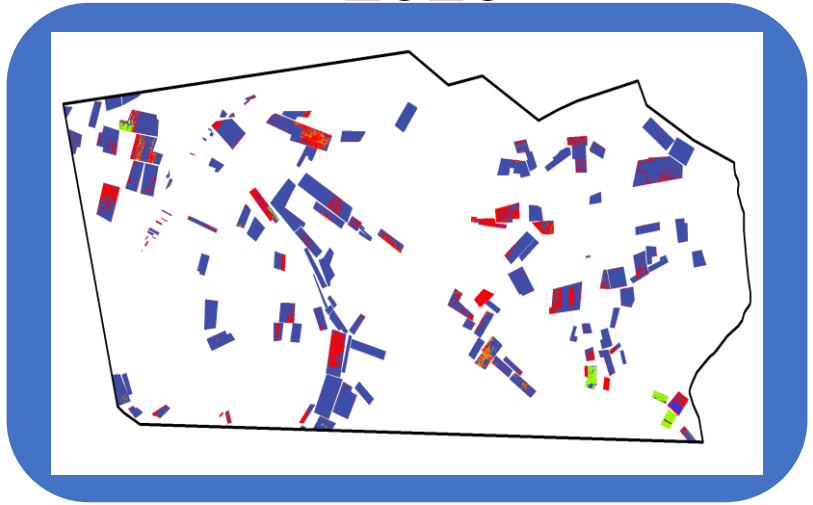
2018



2019



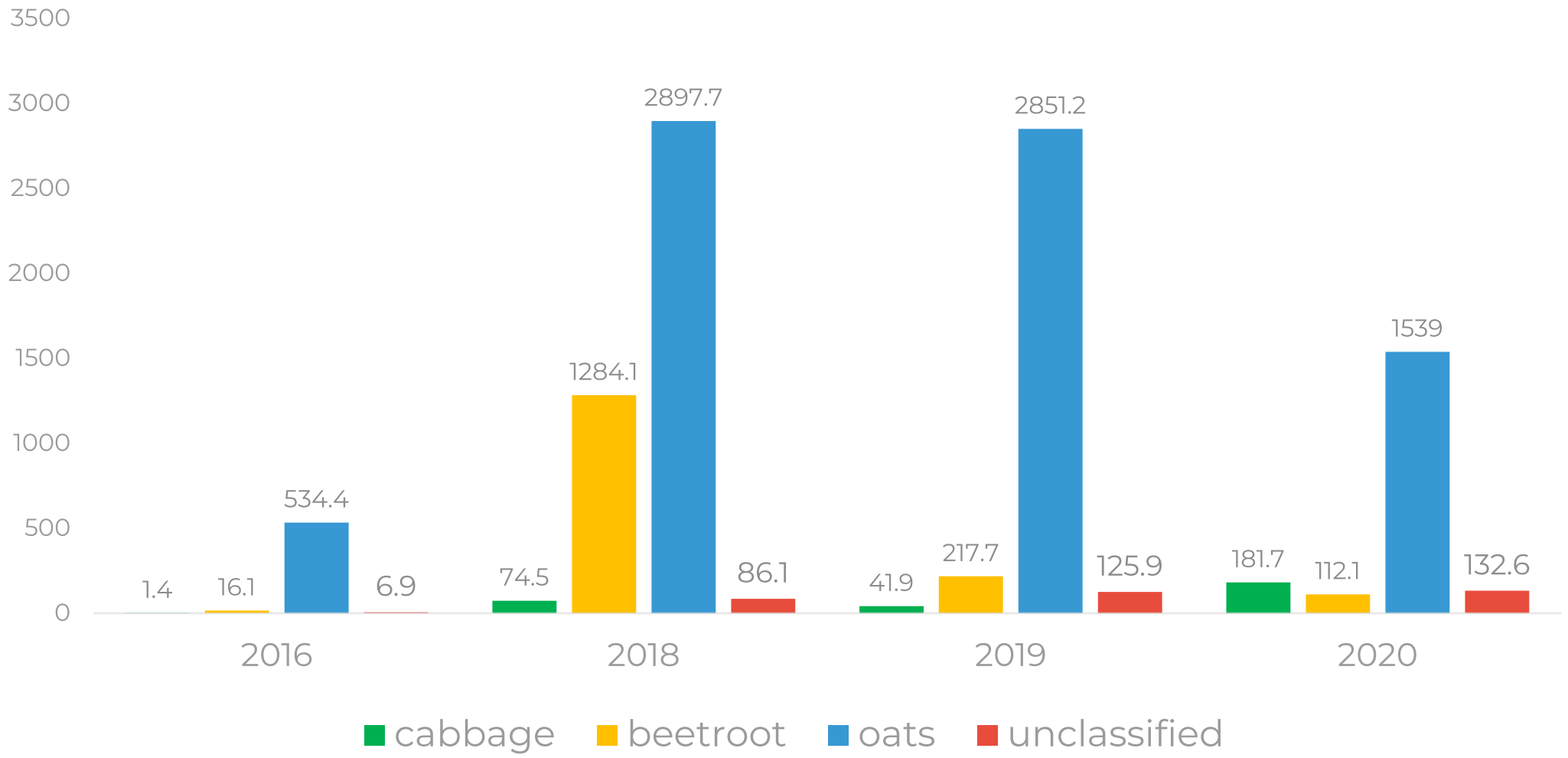
2020



Unclassified
Cabbage
Beetroot
Turnip
Oats

RESULTS

Overall accuracy - 92.85 %
Kappa coefficient - 89%



CHALLENGES

- Compile a spectral database of cultivated plants to establish spectral signatures to measure quality,
- Record the spectral values of major pasture vegetation in order to distinguish pasture areas in addition to crop types.

COMPARISON OF METHODOLOGIES

Methodology	Strengths	Weaknesses
Random forest	Commonly used	Data to use not available yet
	Used by other international researchers in their research	Depends on the resolution of satellite data
	It is possible to estimate crop yields	
SAM	No large amount of information is required	Vegetation spectral indices data not available yet
	It has good accuracy based on vegetation spectral index data	Depends on the resolution of satellite data
	It is possible to estimate crop yields	

CONCLUSIONS

As for the methodology, our experience shows:

- Apply the SAM method for crop type classification,
- Apply the Random forest for crop yield estimation,

As for further action to be taken to apply this test into practice:

- To develop an open source system similar to Sen2Agri system based on the SAM and Random forest methods in the future,
- To allocate more budget and train the NSO’s human resources for remote sensing,
- To explore possibilities of using remote sensing in Agricultural Census 2022 in Mongolia,

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THANK YOU

FOR YOUR ATTENTION