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

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INTRODUCTION

METHODOLOGY

• Random Forest
• Sample Angle Mapping
• Comparison of methodologies

CONCLUSIONS
STEP OF DATA COLLECTION

- **Enterprises, Households**
  - To provide accurate information

- **Bagh**
  - Questionnaire
  - Deliver data to soum

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

- **NSO**
  - Integrate into the country
  - To verify
  - To share

**Statistics**
- 17500 enterprises
- 5 Questionnaire
- 1810 bagh
- 339 soum
- 100+ indicators
- 9 times a year
PROJECT IMPLEMENTATION PLAN AND METHODOLOGY

01 Statistical data
02 Satellite image
03 Analysis
04 Result
05 To introduce
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

1. Atmosphere correction
2. Cloud masking

Band combination

Vegetation index

Random forest Classification

Samples on crop type

Training samples

Test samples

Accuracy assessment

Map of arable land

Field measurement

Processing
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)

Field data

→

Sentinel 2A images Level 1C

Atmospheric correction

Resampling to 10 x 10 m

→

ESA SEN2COR toolbox

Reprojection to UTM 48N WGS84

Resampling to 10 x 10 m /bands 2 to 4 and 8/

→

Spectral data

Spectral signatures

Spectral Angle Mapper
METHODOLOGY Nº2. SPECTRAL ANGLE MAPPER (SAM)
RESULTS

2016

2018

2019

2020

Unclassified
Cabbage
Beetroot
Turnip
Oats
Overall accuracy - 92.85 %
Kappa coefficient - 89%

RESULTS
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

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Strengths</th>
<th>Weaknesses</th>
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<tbody>
<tr>
<td><strong>Random forest</strong></td>
<td>Commonly used</td>
<td>Data to use not available yet</td>
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<tr>
<td></td>
<td>Used by other international researchers in their research</td>
<td>Depends on the resolution of satellite data</td>
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<td>It is possible to estimate crop yields</td>
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<tr>
<td></td>
<td>No large amount of information is required</td>
<td>Vegetation spectral indices data not available yet</td>
</tr>
<tr>
<td><strong>SAM</strong></td>
<td>It has good accuracy based on vegetation spectral index data</td>
<td>Depends on the resolution of satellite data</td>
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<td>It is possible to estimate crop yields</td>
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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,
THANK YOU
FOR YOUR ATTENTION