FOREST AREA DERIVATION FROM SENTINEL DATA

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ABSTRACT: The aim of this study is to compare the changes that occurred in the main forest cover classes of Khangal. For this purpose, remote sensing (RS) and geographical information system (GIS) data sets, as well as national forest inventory (NFI), are used. The study area is located in northern region of Mongolia. Mixed forest is dominating in the study area.
FI methodology were applied for the Sentinel data in order to estimate mixed forest coverage. We developed method of detecting forest cover using Elevation and FI derived from Sentinel data. The output map was compared with ground truth measurements and thematic map. In this study, we tested the ability of Sentinel 2 for forest type mapping in a northern part of Mongolia. The Sentinel data and the described methods are well suited for forest change detection between consecutive years. The result shows that there is high accuracy. The agreement between FI map and ground measurements was 85%. FI index is applicable for different forest type in region.

KEY WORDS: Sustainable management, Forest Index, Remote sensing, Change detection

1. INTRODUCTION

Mongolia is the seventh largest country and one of the biggest land-locked nations in Asia. Management of forest resources in Mongolia suffers from several weaknesses such as unregulated use, overuse, and inadequate protection (Tsogtbaatar 2002). Methodology schema for define forest cover. Forestry has been an important industry for Mongolia and has great potential today as a source of sustainable livelihoods for those in forested provinces. Forest sector uses satellite data from 1990, and started to produce forest cover map using remote sensing. Nowadays many researches for forest cover mapping, forest type, forest degradation, fire of forest, inspected area uses active and passive remote sensing. In Mongolia, most research focused on using forest inventory statistics to estimate total forest area to further explore remote sensing or sources lacking image-based spatial information (Norovsuren et al., 2019) and small scale uncertainties still existed in some related researches. The main goal of this study was to map the change of forest area using satellite image data and the ground truth data. The forest index (FI) is derived from three green, red and near-infrared (NIR) bands and an FI image can be classified into forest and non-forest map with a threshold (Ye, Li, Chen, & Zhang, 2014). Ground truth data for 2018 was applied in this research.

2. MATERIALS AND METHODS

2.1 Study area

The study area, Bulgan province, Khangal sum is located in the Sub-tundra zone, forest steppe zone and steppe zone (about 450 km north of the capital city, Ulaanbaatar). The Mongolian forests are mainly coniferous, mixed with some broadleaf trees that grow on the mountain slopes between 800 - 2500 m above the sea level (UN-REDD 2018). They tenure decade certification for 164157.1-hectares square rehabilitation, appropriate utilization and forest protection regards to agreement of forest resource. This area has a subarctic climate where the annual average temperature is -1.3 degrees Celsius (29.7 degrees Fahrenheit) and total annual precipitation averages is 278.4 mm. The north of the province is characterized by alpine forests, gradually blending in the arid steppe plains of the central Mongolian highland (Figure 1).

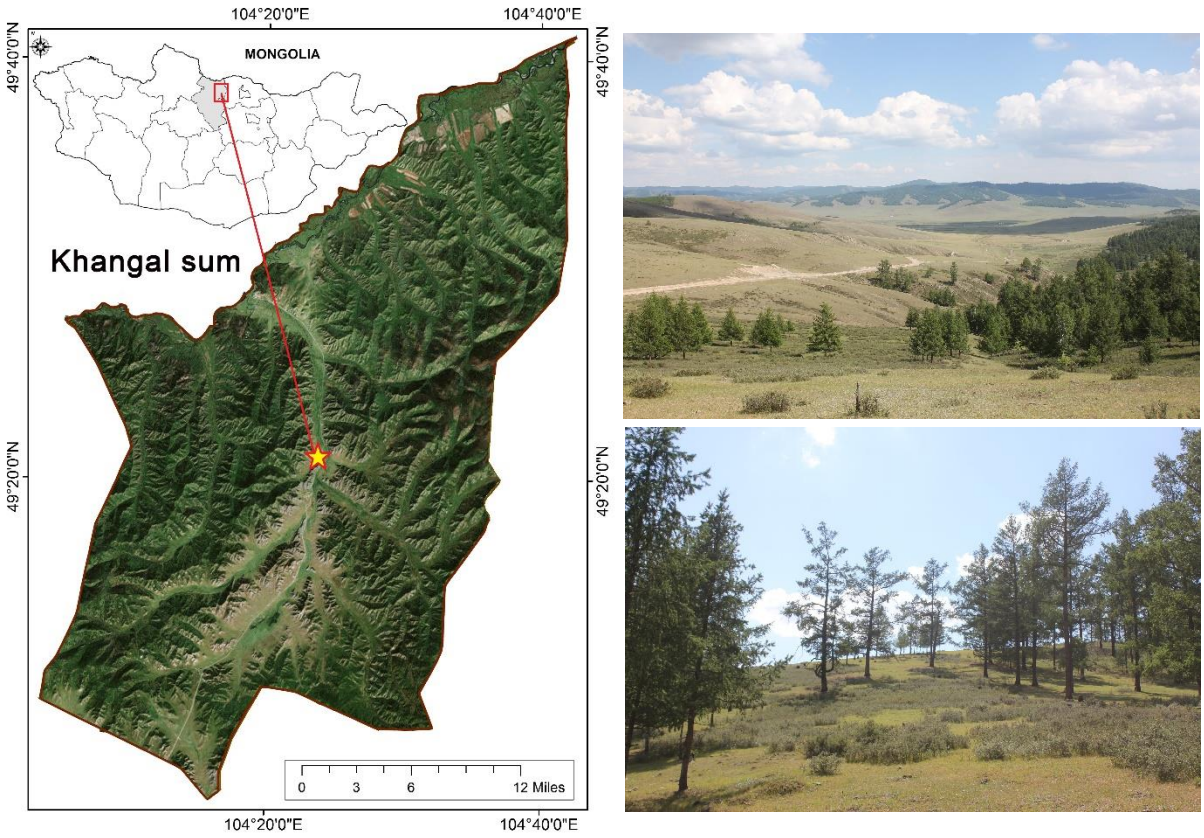

Figure 1. Location map, Khangal soum in Bulgan province

2.2 Methodology

We used Remote sensing methodology for the high resolution and middle-resolution satellite data. Assessment processed with the layer of the data such as Forest taxation data of the FRDC, Google Earth Pro and Bing map used GIS softwares. We used vegetation indexes and forest index for the Sentinel satellite data when we define forest cover area of Mongolia.

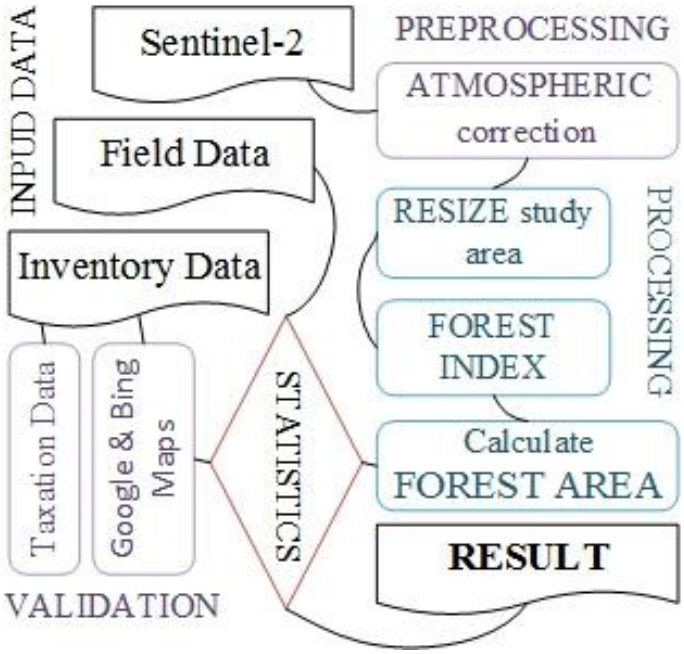

Figure 2. Methodology schema for define forest cover

Forest Index /FI/

Vegetation indexes created for define vegetation and non-vegetation area not for forest and non-forested area. That is why it is difficult to differentiate similar area between forest and non-forest vegetation area. The reason of that we picked up Forest index for our research of equation (1).

FI equation:

$$FI_{predection} = \left(\frac{NIR}{RED}\right)\left(\frac{c_1 - \rho_{NIR}}{c_2 + \rho_{green}}\right) \qquad (1)$$

where $L = 0.01$
$C1 = 1$
$C2 = 0.1$

Forest index threshold chosen as 2.4 and produced land cover map of forest community area from 2018 from the Sentinel data. Forest part border is possible to image via Sentinel and make better high-resolution satellite data.

3. RESULTS AND DISCUSSION

We completed three level validation during the project for validate forest cover map from the forest index. First level was Base error matrix method that create about 5000 grid sample by 500 meter and assess forest/nonforest manually. After that, we went to community area by field trip in July measured differenced sample points of accuracy assessment. Last level of validation is random sampling method validated by field trip of August.

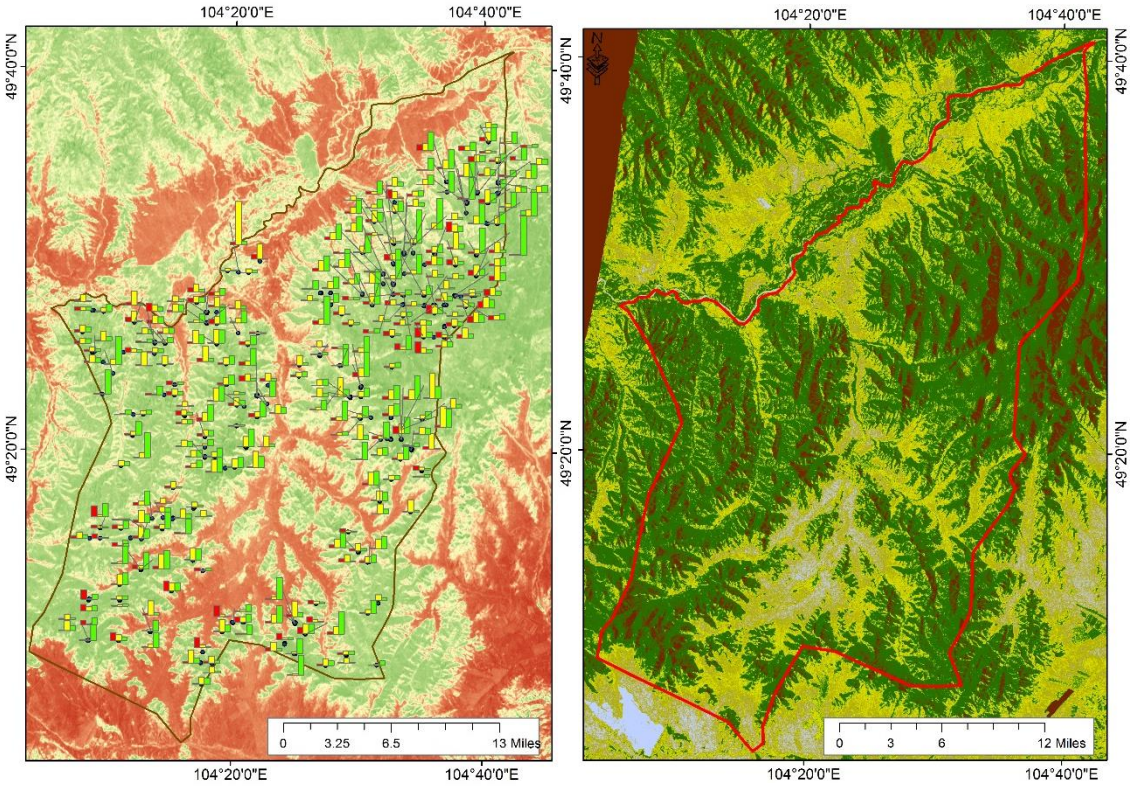

Figure 3. Forest cover in assessment area

Validation

We manually assessed every sample point as forest or nonforest in taxation data or Forest index value. We went to field trip to check not validated points of forest in August. Usually those points located in the forest edge. Overall result of accuracy assessment in Khangal sum of forest index is 87.5%.

The accuracy assessment of Khangal sum area by forest index

Validation points picked up and checked by June and September field trip in forest community areas.

Those points show us the threshold of 2.4 is suitable for Mongolian forest and Forest index true meaning of insitu data.

Distribution of forest index value

The 52 percent of 500 samples of forest community area taken greater value than (2.4). 91.3 percent of forested 344 points taken the value of greater than (2.4). From all those results, we decided to pick up 2.4 as a forest threshold of forest index in Mongolia. However, if there is no data in forest growth period then early spring and late autumn data should have taken threshold as (2.7).

4. CONCLUSION

Forest is more distinctive on any forest index during growing summer time. Community partnerships are possible to analyze on forest pest, fire, cut down, shortage area and long-term monitoring through Sentinel satellite data. FI map was overlaid and compared on Inventory map. These results indicate that the FI can effectively highlight forest cover. Forest boundary have possible to mapping on Sentinel or other high-resolution satellite data.

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