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SOME RESULTS OF CROP STRESS MONITORING BY REMOTE SENSING IN NORTHERN MONGOLIA

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ABSTRACT

This paper presents the spatiotemporal monitoring crop stress in the first period of wheat phenology by satellite image in northern Mongolia. We used 2 satellite images Landsat8 that are dated June 23rd and July 12th of this year. Also calculated are same ratio-based indices such as NDVI, LAI and GNDVI of 2 images in the middle period of wheat phrenology, which are indicated crop stress field reports. NDVI and LAI, derived from satellite imagery are the most important characteristics of wheat stress monitoring. According to our result, as shown satellite image, wheat growth is critical and fuzzily, which is predicted necessary some management for farming. Our results show the ability of pre-processing image to analyze and visualize agricultural environments and workflows has proven to be beneficial to those involved in the farming industry.

KEY WORDS: remote sensing monitoring, crop stress, NDVI, LAI, GNDVI

INTRODUCTION

In consideration of public policy intensive agricultural production in Mongolian crop land reached to more than 1.2 million hectares in the last 60 years and in 1986-1990 an average of 784.8 thousand tons of grain per year (including wheat, 638.0 tons of potatoes, 46.2 thousand tons vegetables) seized a comparably heavy 270-290 kg of grain, about 150-160 kg of wheat and 20 kg of vegetables a share of the country's population, and this time was possible to fully meet the domestic needs. According to the unified land fund report of Mongolia, crop land in 2016 is 1,067,7 thousand hectares which is included abandoned area with 260,6 thousand hectares [5]. However, in recent years, increased crop land has been playing an important role in supplementing domestic demand for food, but climate change and seasonal harvest play an unpredictable factor. Monitoring crop growth using optical remote sensing technology and satellite data offers an opportunity to explore vast areas in a short period of time. Nowadays, remote sensing air and satellite imagery based on the survey data and the available crop land monitoring or processing of data collected in the field a study based on the monitoring point of selected area. The northern part of Mongolia, where over 90% of the country’s crop land is, is geographically and climatically suited for agriculture . Global warming is causing decrease in precipitation and an increase in the number of warm days but does not change in crop yields in the irrigated crop land. As far as Mongolia is concerned, many studies have shown that it is desirable to consider changes in vegetative chlorophyll as a monitoring of satellite imagery to monitor the situation of crop land and crop stress. **Site Description** Data for this study was collected on or near the northern border of Mongolia, in the Selenge image of the central cropping region, Mongolia, which is located in 71°17'01" N, 156°35'48" W, at an elevation of 890-1120 m above sea level. The central cropping region is included in crop land of Selenge, Tuv and Bulgan images. The area currently in use is 569145 hectares and has a relatively brown and dark brown soil with a humidity of 4.2-2.8%, in some areas of the forest steppe and steppe zone of the arid area, and the light brown soil of 1.3-2.2% is widely distributed. 50% or 821208 hectares soil of the central cropping region is included into the 2nd category of the Agra-production zoning. The climate is steep with humid climate with an average annual precipitation of 230 mm. Our detailed study takes out in 1,500 hectare wheat with irrigation and 6,000 hectares without irrigation systems. It is located in the southeast of Tsagaan Nuur some of Selenge aimag, 99 km north-west of the Selenge image center and 383 km from Ulaanbaatar.

MATERIAL AND METHODS

We used open sourced satellite image Landsat 8, the most recent satellite of the series, which promises to maintain the continuity of Landsat 7. However, in addition to subtle differences in sensor characteristics and vegetation index (VI) generation algorithms, VI's respond differently to the seasonality of the various types of vegetation cover [4]. The purpose of this study was to elucidate the effects of these variations on VIs between Operational Land Imager (OLI) and Enhanced Thematic Mapper Plus (ETM+). Ground spectral data for vegetation were used to simulate the Landsat at-senor broadband reflectance, with consideration of sensor band-pass differences. LandSat8 with sensor OLI that has 12 bands, and a 30-meter resolution, which is made atmospheric and geometric correction.

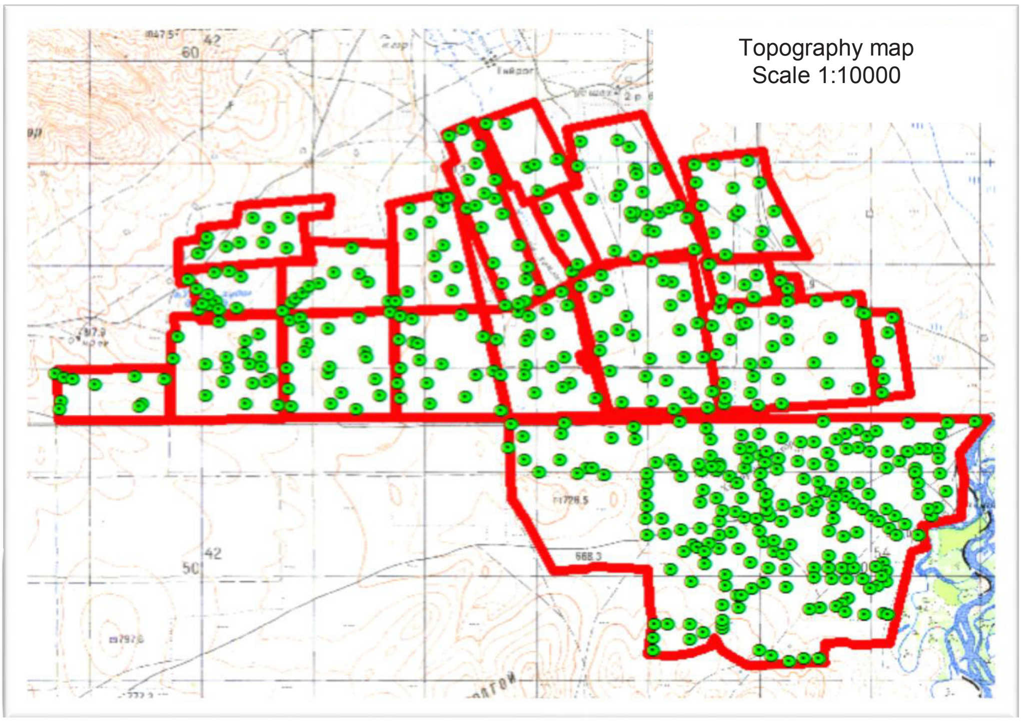

Figure 1. Crop land in Tsagaannuur sum Selenge aimag

For control and relation satellite data to ground data, we are using 28 monitoring points in the cropland where wheat is growing differently.

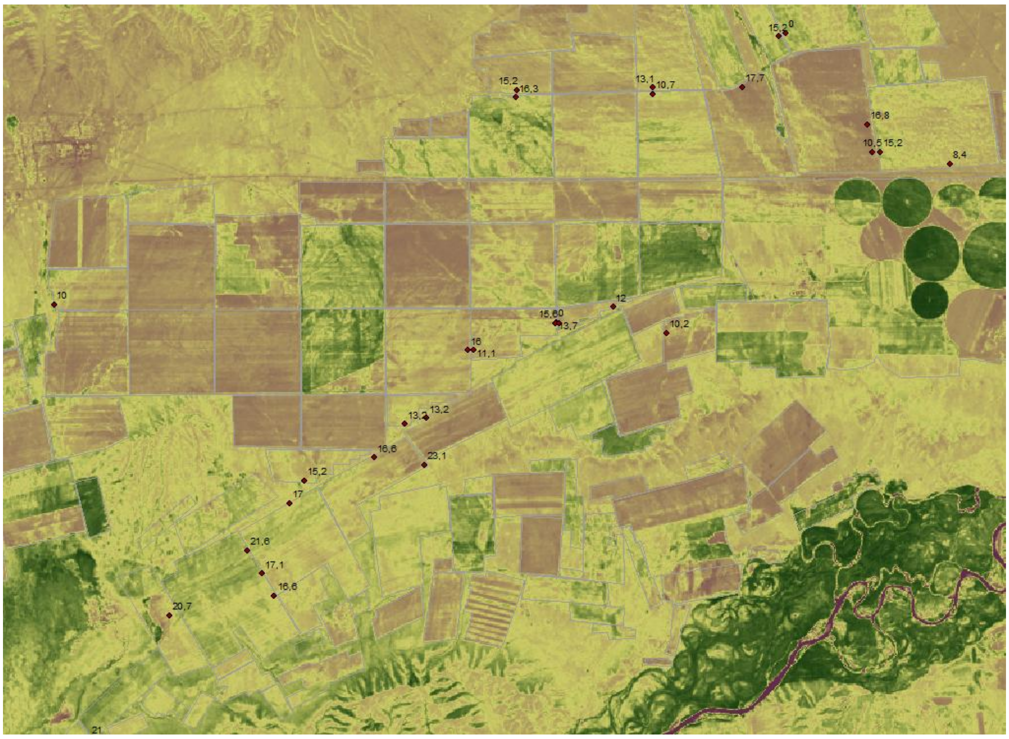

Figure 2. Monitoring point in cropland

We calculated the normalized difference vegetation index (NDVI) in a simple graphical indicator that can be used to analyze remote sensing measurements, typically but not necessarily from a space platform, and assessed whether the target being observed contains live green vegetation or not [1]. The NDVI is calculated from these individual measurements as follows,

$$\mathrm{NDVI} = \frac{(\mathrm{NIR} - \mathrm{VIS})}{(\mathrm{NIR} + \mathrm{VIS})} \quad (1)$$

where red and NIR bands for the spectral reflectance measurements acquired in the red (visible) and near-infrared regions, respectively. The statistics of NDVI image which is driving from LandSat8 image from June 23rd this year show maximum values of 0.931, minimum value of 0.5235 and mean value of 0.42222, standard deviation 0.14 which is showing most of crop land obtained low NDVI value below the average value but crop land in irrigation system obtained high value. Image NDVI shows the most of wheat in red. The explanation for statistics of NDVI is that this region has a dry climate with less precipitation so the wheat growth is not normal in the middle stage its growth phenology which yield can be delayed. The pre-processing image of July 12th shows that NDVI low value has decreased to 0.96 which means that green cover is in extreme situations and what is under stress.

a. b.

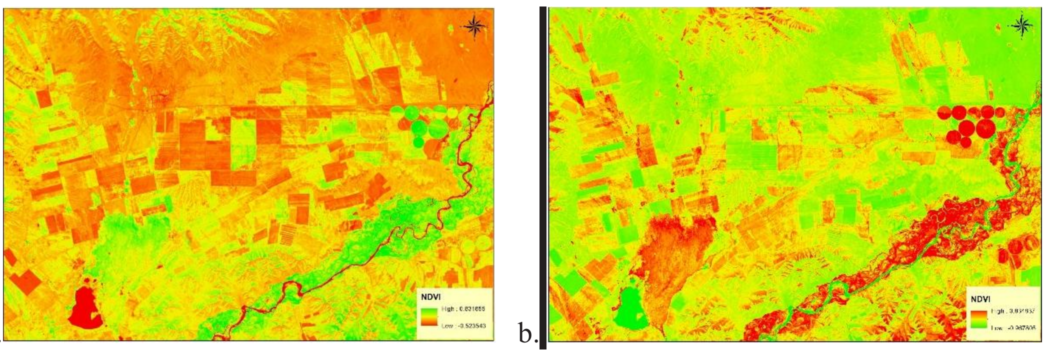

Figure 3. NDVI of crop land, (a. June 23, b. July 12)

One of important parameter of monitoring vegetation stress is leaf area index (LAI) (Breda, 2003) which indicated the ratio of leaf surface per unit ground area [7]. The LAI is calculated from these satellite images as follows

$$LAI = 0.57*xp(2.33*NDVI) \qquad (2)$$

where, LAI- leaf area index, NDVI – normalized difference vegetation Index

According to results of raster calculation, NDVI image using a raster calculator for LAI on June 23rd, which high value is 3.96 in irrigated plots and mean is 1.56 in another region, which is so low than standard value. It can describe what is growing not density and leaf area which is showing growth of wheat is less. LAI wheat in image of 12 July shows some differences such as low value decreased in 0.06, but the mean and high value are increased. It means most of the wheat is growing better than previous period and means leaf area wheat is increased.

a. b.

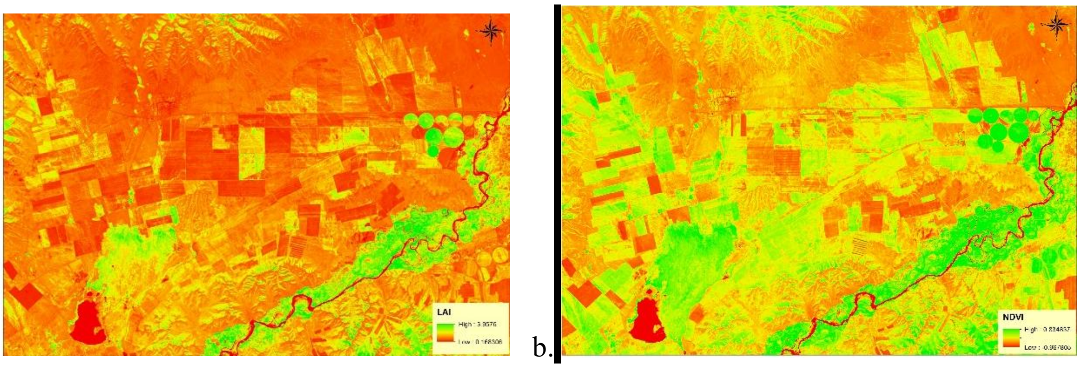

Figure 4. Leaf area index, LAI, (a. June 23, b. July 12)

One of the most widely used ratio based indices is Green Normalized Difference Vegetation Index (GNDVI) [2] respond to these differences in the near infrared and visible regions [3]. The Green Normalized Difference Vegetation Index (GNDVI) is an index of plant "greenness" or photosynthetic activity, and is one of the most commonly used vegetation indices to determine water and nitrogen uptake into the crop canopy. This index can classify the crops by type using NIR and visible Green brands of LandSat8 and the using following equation.

$$GNDVI=(NIR-Green)/(NIR+Green) \quad (3)$$

a. b.

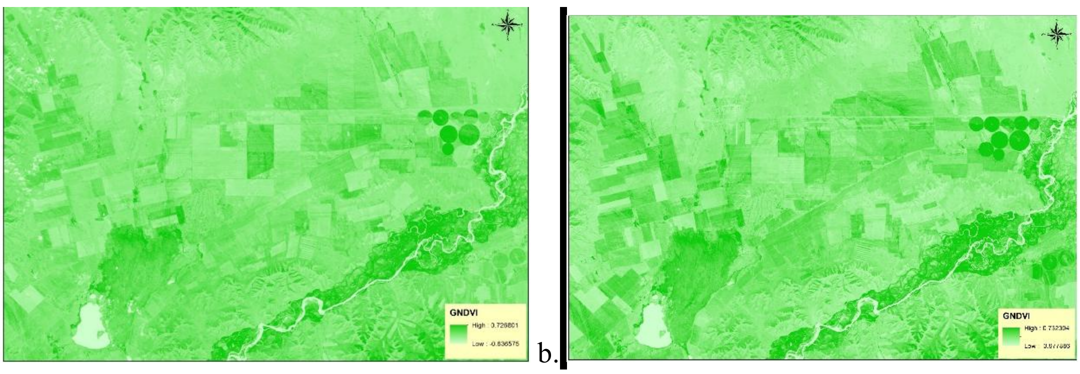

Figure 5. GNDVI, (a. June 23, b. July 12)

As image shown most of the area is obtained low value than men. It can be described homogenous crops in this area. During the monitoring period greenness is decreased.

RESULTS AND DISCUSSION

Firstly, we compared first stage of the phonology period of wheat growth by LandSat8 image to OLI sensor, which is indicated by NDVI, LAI and GNDVI. We analyzed the NDVI and LAI, which has important characteristics showing the genealogy process of crop and crop stress. The result of change detection 2 pre-processing image show what is growing under climate stress? According to our result, wheat growth is critically and fuzzily, which is showed necessary some management for farming. Our results show the ability of pre-processing image to analyze and visualize agricultural environments and workflows has proven to be beneficial the those involved in the farming industry.This analyze shows only one stage of wheat phenology furthermore for better analyze and monitoring crop stress we need high spatiotemporal resolution satellite image for agricultural precision mapping for farming.

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