

DETERMINATION OF SOIL LINE USING REMOTELY SENSED DATA

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KEYWORDS: NDVI- Perpendicular Vegetation Index, MSAVI- Modified Soil Adjusted Vegetation Index, PVI- Perpendicular Vegetation Index, soil line, LANDSAT(TM, ETM)

ABSTRACT

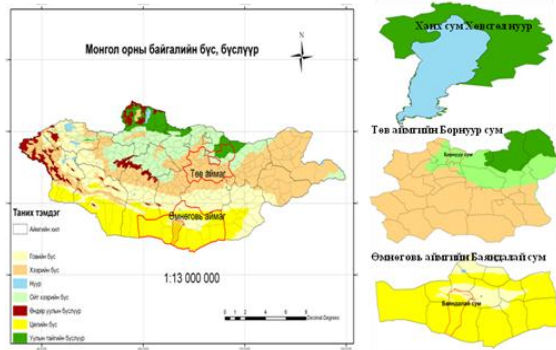
The purpose of my research is to determine the Mongolian soil line using remote sensing data, ArcGIS and ENVI. To determine the soil line, we define which indices can be calculated in different zones. The soil line is a linear relationship between the near-infrared (NIR) and (RED) reflectance of bare soil as characterized by the slope and intercept parameters. The soil line is characteristic of the soil type and is used to define vegetation indices which allow for the subtraction of the effects of soil optical properties from spectra. Perpendicular Vegetation Index (PVI) is calculated using the soil line while Normalized Different Vegetation Index (NDVI) and Modified Soil Adjusted Vegetation Index (MSAVI) are calculated using only ground truth.

1. INTRODUCTION

Mongolia has variable climatic conditions, low atmospheric moisture and agriculture without irrigation. The effectiveness of agriculture depends on climatic and natural conditions as well as on the moisture of the soil. Soil geographic science originated in the intersection of soil science and geography, so its theoretical knowledge came from each science and has strong theoretical fundamentals.

Since people have been growing plants they have been accumulating extensive knowledge about the soil. They had different definitions and understanding during initial exploration, but all definitions of the soil related to its ability to grow plants. In the last half of the 19th century, knowledge about soil and its theoretical base developed in new stage and humans started to study the soil from the viewpoint of geography, geology, biology, and nature study. Soil geography studies the factors for environmental conditions suitable for growth, particularly soil origin processes and their interaction and differentiation in space.

2. STUDY AREA



My study area Bayandalai sum in Umnogobi province (E103° 7', N43° 2'), Bornuur sum in Tuv province (E105° 8', N48° 9') and Khovsgol lake in Khovsgol province (E100° 2', N50° 3'). The study area is shown in Figure 1.

Figure 1. Study area (Bayandalai sum E103° 7', N43° 2', Bornuur sum E105° 8', N48° 9' Khovsgol lake E100° 2', N50° 3')

3. USED DATA AND METHODOLOGY

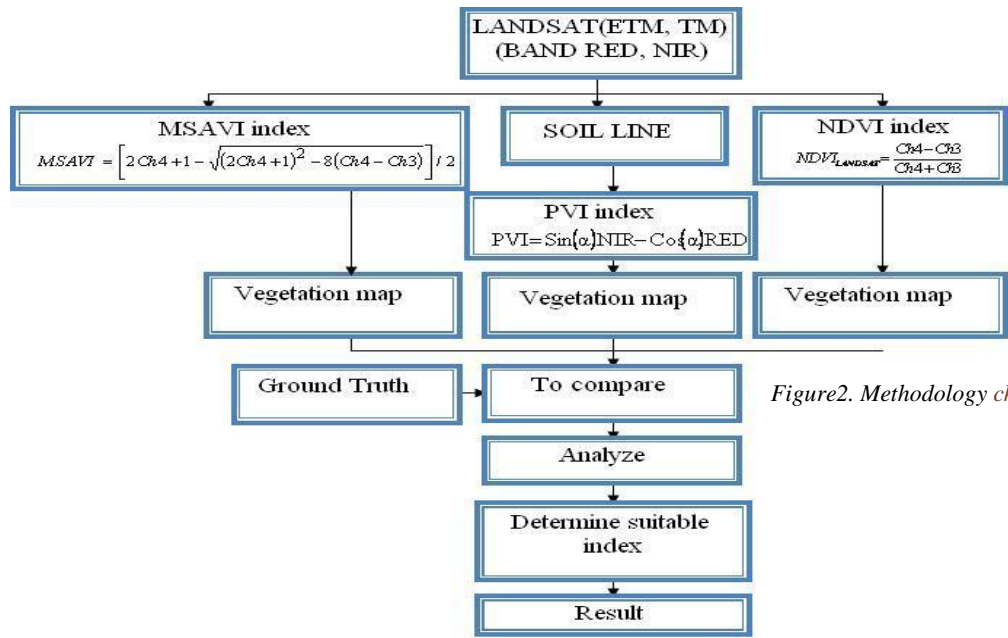


Figure 2. Methodology chart

Normalized Difference Vegetation Index (NDVI) – LANDSAT data is the Normalized Difference Vegetation Index (NDVI), which is derived from the visible red (RED) and near-infrared (NIR) channels:

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

RED-channel 3 of LANDSAT data (0.58 μm– 0.68 μm)

NIR – channel 4 of LANDSAT data (0.725 μm -1.1 μm)

Modified Soil Adjusted Vegetation Index (MSAVI) – LANDSAT data is the Modified Soil Adjusted Vegetation Index (MSAVI), which is derived from the visible red (RED) and near-infrared (NIR) channels:

$$MSAVI = \left[2NIR + 1 - \sqrt{(2NIR + 1)^2 - 8(NIR - Red)/2} \right] \quad (2)$$

RED-channel 3 of LANDSAT data (0.58 μm – 0.68 μm)

NIR – channel 4 of LANDSAT data (0.725 μm -1.1 μm)

Perpendicular Vegetation Index (PVI) - LANDSAT data is the Perpendicular Vegetation Index (PVI), which is derived from the visible red (RED) and near-infrared (NIR) channels:

This VI allows for soil lines of different slope but is highly sensitive to atmospheric variation: (Richardson and Wiegand, 1977).

$$PVI = \sin(\alpha)NIR - \cos(\alpha)RED \quad (3)$$

where (α) = the angle between the soil line and the NIR

4. ANALYSIS

1. Soil line of Bayandalai sum

After comparing the approved control card of pasture land and map from LANDSAT satellite we will select measuring point in dry bare soil, then infrared and near infrared ray range we will determine soil line. In figures 3-5 illustrated soil line of Bayandalai sum. To validate the line of dry and bare soil we're using data for 3 years.

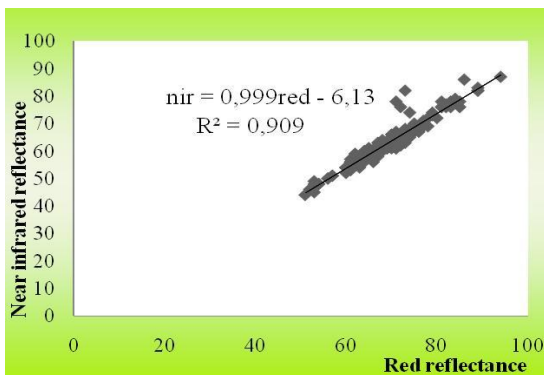


Figure 3. Soil line of Bayandalai sum 2010

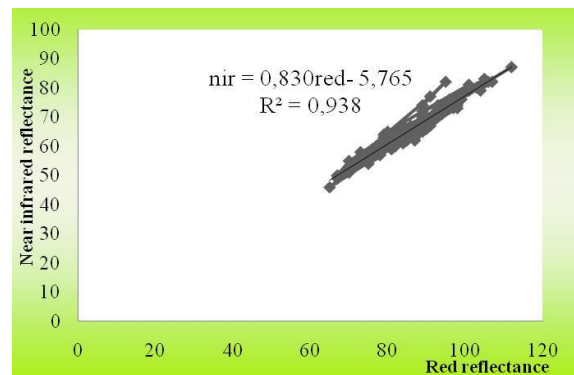


Figure 4. Soil line of Bayandalai sum 2009

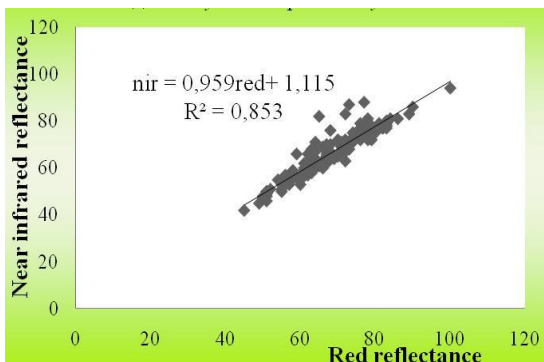


Figure 5. Soil line of Bayandalai sum 2006

Ground truth to the bare, dry soil clean grow Bayandalai sum's vegetation is lowly, soil is high. It shows the ground truth is very nearly in soil line. Using of 2006, 2009 and 2011 Landsat satellite data calculated MSAVI, NDVI, PVI map of obtain of vegetation map. Calculated PVI using of soil line. (Figure 7-9)

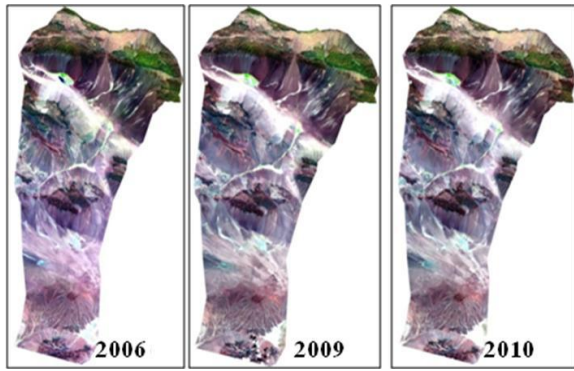


Figure 6. True color combination of Bayandalai sum

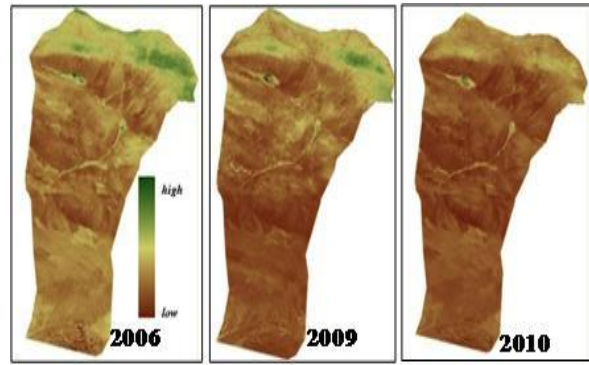


Figure 7. Vegetation map MSAVI of Bayandalai sum

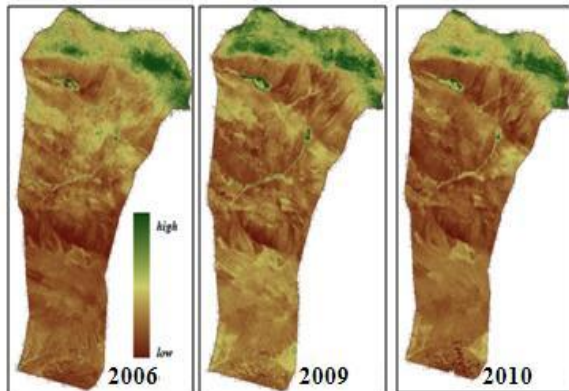


Figure 8. Vegetation map NDVI of Bayandalai sum

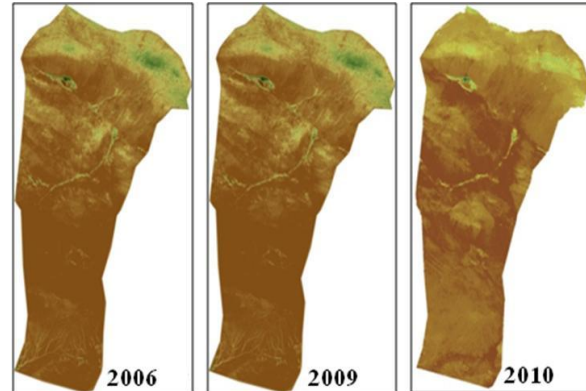


Figure 9. Vegetation map PVI of Bayandalai sum

To look at from vegetation map, calculated MSAVI value is greatly showed difference of bare soil. But NDVI value vegetation map is poorly showed deference bare soil and vegetation.



Figure 10. Trend NDVI and MSAVI value of Bayandalai sum

MSAVI index is greatly sensing of bare dry soil line. The index value (MSAVI) and (NDVI) figure 10. Compare MSAVI and NDVI value is is MSAVI values mean is too high.

To results MSAVI index is suitable in dry and bare soil.

2. Soil line of Bornuur sum

Bornuur sum in Tuv province selected to determine soil line, because it has densely covered vegetation from comparing ground truth and satellite data. Using of RED and NIR channel of landsat data 2006, 2009 and 2010 to obtain soil line using. (Ficture 11-13)

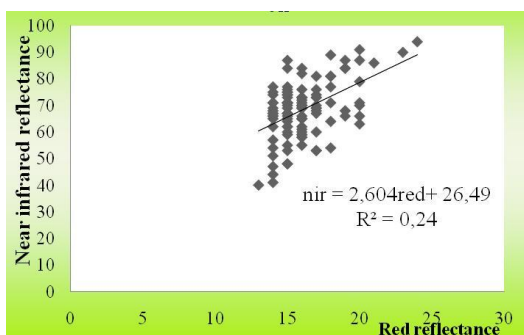


Figure 11. Soil line of Bornuur sum 2010

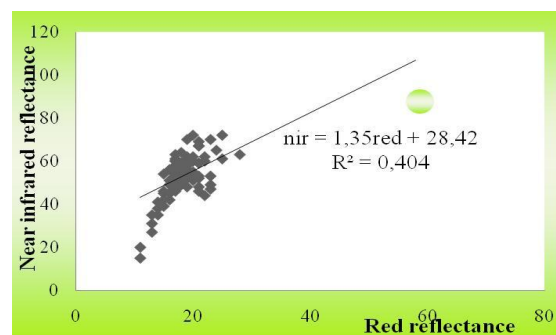


Figure 12. Soil line of Bornuur sum 2009

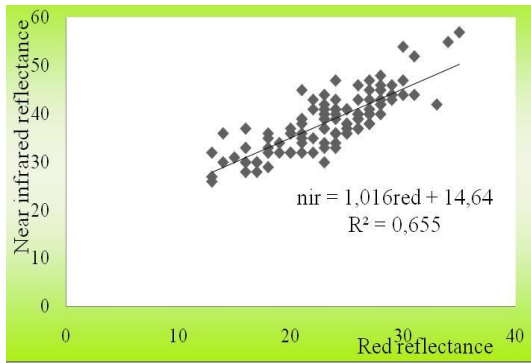


Figure 13. Soil line of Bornuur sum 2006

Vegetable covers reflectance means through the soil line sum parts accumulating is very. Dispersance density and distance of soil line. RED is too sensing fewer of clean vegetation mean of reflectance is very low value. NIR is greatly sensing of clean vegetation, and mean of reflectance is very high value.

We used 2006, 2009 and 2011 Landsat satellite data to calculate MSAVI, NDVI map. We calculated PVI using the soil line. (Figure 15-17)

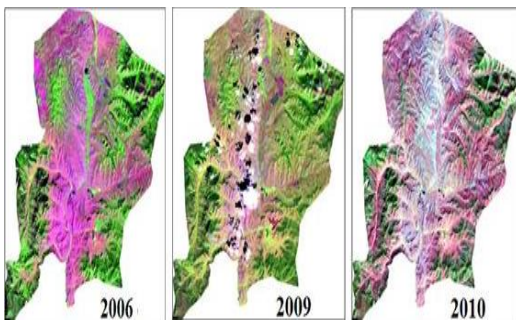


Figure 14. True color combination of Bornuur sum

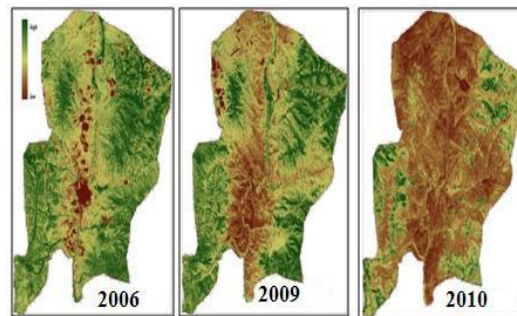


Figure 15. Vegetation map NDVI of Bornuur sum

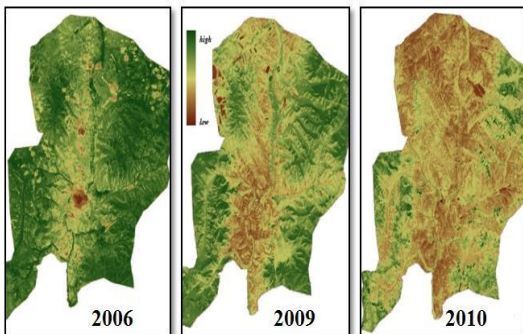


Figure 16. Vegetation map MSAVI of Bornuur sum

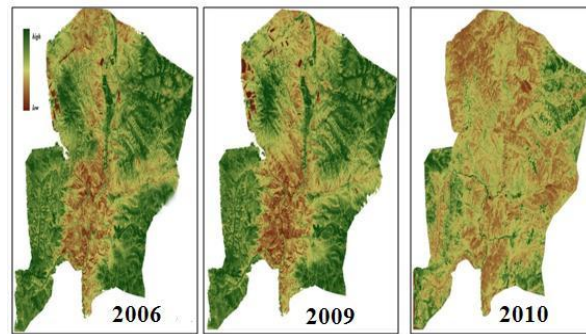


Figure 17. Vegetation map PVI of Bornuur sum

The figures show NDVI, MSAVI, PVI index. This figure show that NDVI index sensed vegetation well and it was high value. Results vegetation cover land calculate NDVI index.

In this results, the NDVI value is high and greatly sensing vegetation land cover to compare MSAVI and NDVI.

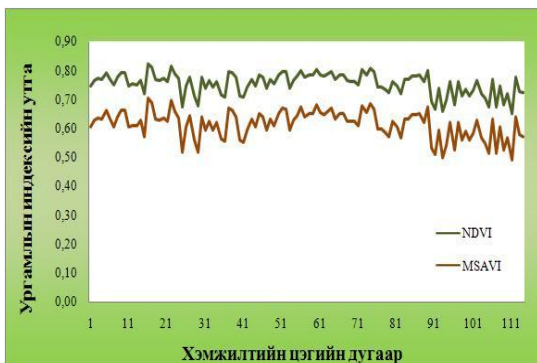


Figure 18. Trend NDVI and MSAVI value of Bornuur sum

5. RESULT AND CONCLUSION

- Bayandalai sum's vegetation is low, soil is high. It shows the ground truth is very nearly in soil line. In this result, MSAVI value is high and greatly sensing dry bare soil to compare MSAVI and NDVI. Steppe zone is suitable compared MSAVI.
- Bornuur sum's vegetation is high, soil is low. It shows the ground truth is **distant** in soil line. suitable compared NDVI. In this results, NDVI value is high and greatly sensing vegetation land cover to compare MSAVI and NDVI.

6. REFERENCES

D.Amarsaikhan, M.Ganzorig, M.Saandari, Ts.Adiyasuren, 2006 “Зайнаас тандах судлал, газарзүйн мэдээллийн системийн зарчмууд”

Ch.Gonchigsumlaa 2008 “Хөрс судлал үүсэл, тархалт, ангилал”

D.Dorjgutuv, N.A.Nogina, K.A.Urimtseva, “Бүгд найрамдах Монгол ард улсын хөрсний зураг” хөрсний атлас 1980

N.Enkhjargal 2010 “Determination of moisture in the southern slopes of the khangai range in mongolia using remotely sensed data”

Ph.D Brigitte Leblon “Soil and vegetation optical properties”

Chris Banman “Remote Sensing of Vegetation and Soil” Dec. 2001