MODELLING EXPOSITION OF LAND SURFACE IN MONGOLIA

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Abstract
The study of this research field develop to highly by technology precisions on science development. When we purposed ecological unit slope of the ground surface on whole country of Mongolia, analysis were used on estimating surface slope from DEM, overlaying classification of surface aspects, and estimating indicator of climate thus using time series information of Satellite images. Finally the results of this study have been detected that 64 types of similar elevation, aspects and slopes in Mongolia.

1. Introduction

The animal husbandry that is a root of Mongolians' lifestyle and civilization is the main agricultural sector of our country. Despite the fact that a great number of external and domestic scientists have explored the Mongolian animal husbandry, most of them had carried out the research from the nomadic, socio-economic and sociological side of the herders. Whereas on the basis many years of basic research, surface conditions and the micro-climate indicators of the research, Ph.D., scientists D.Bazargur, S.Shiirev-Adya and B.Chinbat [1] have developed the subdivision in terms of the ecologically pertinent zones of the animal husbandry.

In modern times, the application of the information provided by the satellite for the environmental condition research and resource studies has given an opportunity to develop various types of thematic images and as a result, reach multi-party conclusions. By applying the information provided by the satellite, this research has attempted to identify the ecological unit slopes of the ground surface and determine the micro-climate indicators on the unit surface as well as determine the mathematical correlation between the surface and the surface weather, climate measurements.

2. Material and Methods

2.1 Satellite data:

2.1.1 MODIS (or Moderate Resolution Imaging Spectroradiometer) is a key instrument aboard the Terra and Aqua satellites. Terra's orbit around the Earth is timed so that it passes from north to south across the equator in the morning, while Aqua passes south to north over the equator in the afternoon. Terra MODIS and Aqua MODIS are viewing the entire Earth's surface every 1 to 2 days, acquiring data in 36 spectral bands, or groups of wavelengths (see MODIS Technical Specifications). These data will improve our understanding of global dynamics and processes occurring on the land, in the oceans, and in the lower atmosphere.

- Land Surface Temperature (MOD/MYD 11A2) 2004-2013
- Snow Cover (MOD/MYD 10A2) 2001-2013

2.1.2 Aster (Global Digital Elevation Model) :A digital elevation model (DEM) is a digital model or 3D representation of a terrain's surface — commonly for a planet (including Earth), moon, or asteroid — created from terrain elevation data.

2.2 Precipitation data:

When determining the precipitation data, applied the precipitation sum data of 31 years or between 1960-1990 and converted the spatial resolution into 500 m. The average wind resource data of Mongolia was developed in terms of the landscape distribution on the basis of years of wind data in relation to the surface conditions. Since the data and information employed for the evaluation and cartography shall have the capacity to demarcate various types, the average capacity to demarcate them in Mongolia was considered as 500 m, hence, all the raster graphics were developed under the capacity of 500 m demarcation.

3. Methods

3.1.1 Determining the surface conditions:

When determining the surface elevation, direction and surface slope, the Ph.D., scientists D.Bazargur, S.Shiirev-Adya and B.Chinbat have applied their methodology and is shown in the following table.

Table 1. Surface class

Elevation/meter/	Aspect /degree/	Slope/degree/	Class
> 1500	90-135^0 (East South)	> 5^0	1
1500-2000	135-225^0 (South)	5-10^0	2
2000-2500	225-270^0 (West South)	10-15^0	3
2500 <	270-90^0 (North)	15^0 <	4

3.1.2

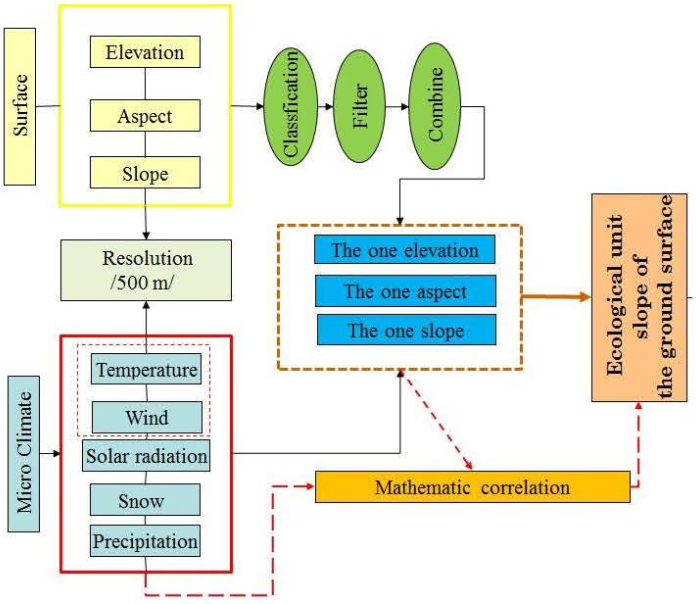

Figure 1. Schema of Study work

4. Result:

4.1.1 slope, aspect and elevation of Surface: Upon developing the elevation data of Mongolia /SRTM/at 90 m and interpreting it at 500 m resolution, as determined by Ph.D. D.Bazargur divided into subdivisions.

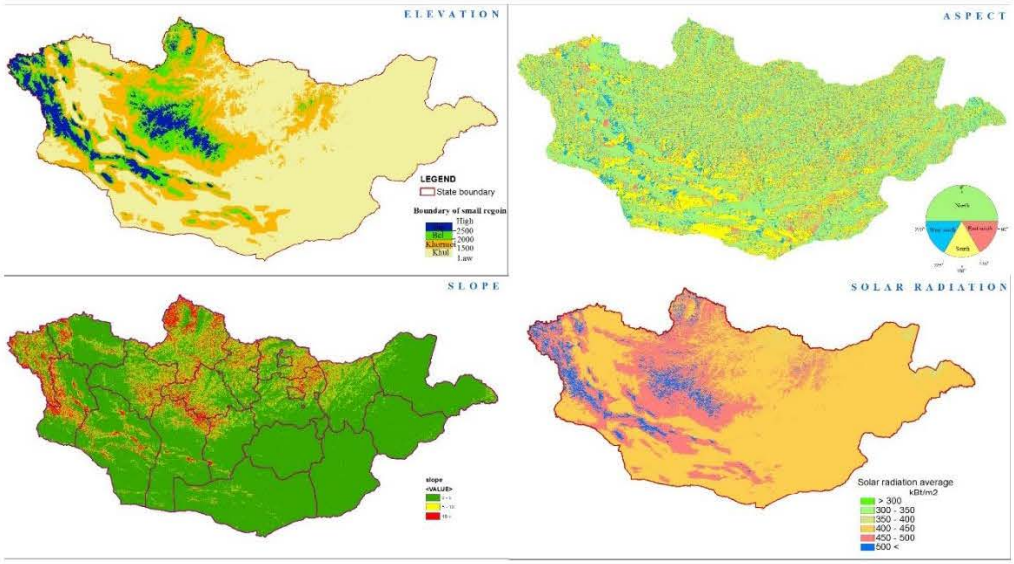

Figure 2. Surface elevation, Surface aspect, surface slope, solar radiation

The areas that are elevated at more than 2500 m such as Mongol Altai, Khangai mountains and Khuvsgul take 5.9 percent; mountain slope areas elevated at 2500-2000 m such as or Altai, Khangai, Khuvsgul, Khentii mountains take 11.1 percent; mountain laps elevated at 2000-1500 m such as Altai, Khangai, Khuvsgul, Khentii mountains take 22.6 percent while mountain foothill areas elevated at less than 1500 m take 60.4 percent of the total territory. When demarcating the surface slope and surface direction under the abovementioned method, the areas with less than >5° slope was 74.8 percent, areas between 5°-10° slope was 15.9 percent, areas between 10°-15° slope was 6.8 percent while areas above 15°< slope was 2.5 percent of the total territory or acquired 3 percent in the south-east, 34.1 percent in the south, 14.8 percent in the south-west and 48.1 percent in the north respectively [7, 8].

The primery component that creates the earth's climate is sunray. The average annual amount of the sum of the sunray in Mongolia identified as lower than 1200m^2 in Altai, Khangai, Khuvsgul, Khentii mountain areas and the annual average of the sunray in desert zone was more than 1500 m^2. The sum of the sunray that is received by the earth varies due to surface conditions. This is proven according to the moment sun hits the mountain top and the last moment the sun shines at the mountain top.

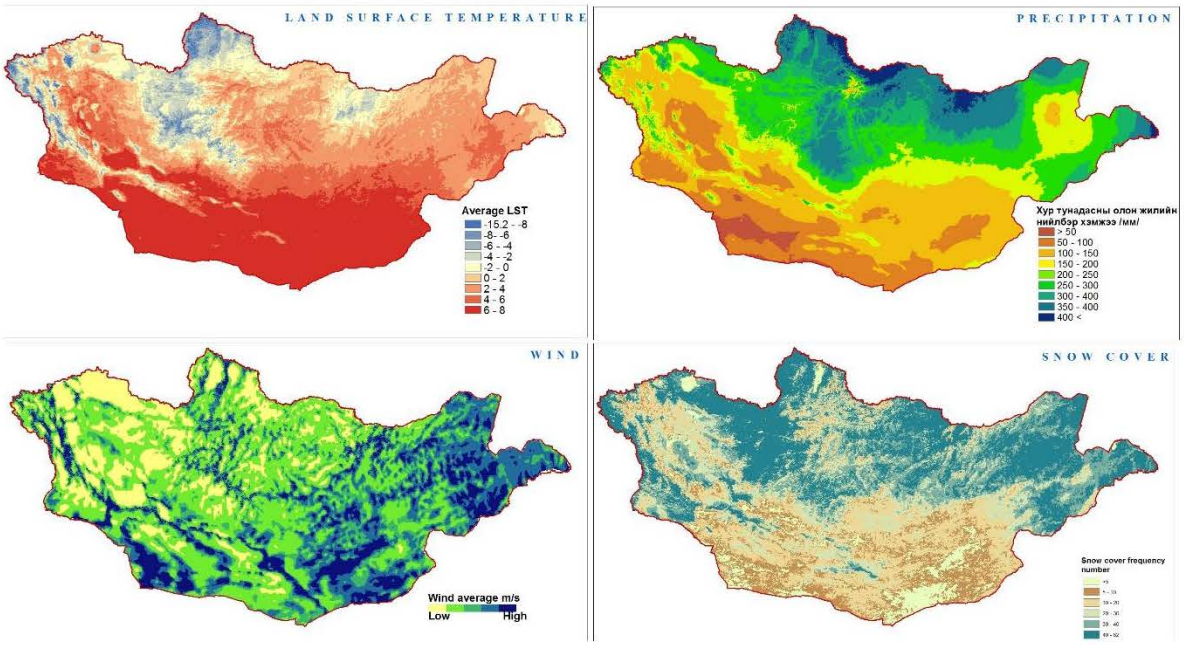

Figure 3. Land surface temperature ,Precipitation, Wind, Snow cover

Land surface temperature: The surface temperature mean at >-8°C area or Mongol Altai mountain, Khuvsgul, Kharkhiraa-Turgen mountains, Otgontenger mountain, snow-capped peaks of high mountains and hills elevated at 1741-4330m make 0.4 percent; surface temperature mean at -8--6°C or Mongol Altai mountain range, Khuvsgul Kharkhiraa-Turgen mountains, Otgontenger and Khentii mountains elevated at 1413-3971 m make 1.6 percent; surface temperature mean at -6-4°C or Mongol Altai mountain range, Khuvsgul, Kharkhiraa-Turgen mountains, Otgontenger, Khentii mountains elevated at 1125-3926 m make 3.1 percent; surface temperature mean at -4--2°C or Mongol Altai mountain range, Khuvsgul, Kharkhiraa-Turgen mountains, Otgontenger, Khentii branch mountains elevated at 604-3886 m make 6.3 percent; surface temperature mean at -2-0°C or Mongol Altai mountain range, Khuvsgul, Kharkhiraa-Turgen mountains, Otgontenger, Khentii, Khingan branch low mountains or steppe zones, Uvs lake and major river valleys elevated at 565-3672 m make 8.8 percent; surface temperature mean at 0-2°C or elevated at 563-3517 m make 14.5 percent; surface temperature mean at 2-4°C or elevated at 564-3149 m make 23.5 percent; surface temperature mean at 4-6°C or elevated at 563-3517 m extending from gobi-steppe region to an elevation of 563-2771 m make 14 percent; and the surface temperature mean at 6°C < or covering the gobi, desert zone at 524-2513 m elevation make 27.7 percent of the total territory respectively.

Precipitation: Upon application of the precipitation sum between the 1960-1990's years in Mongolia, the spatial precipitation distribution was determined. Since Mongolia has extreme continental climate, the precipitation is low and over 90 percent of the annual precipitation

occurs only in June, July and August while the remaining less than 10 percent occurs in the remaining period. As seen from the distribution of many years of precipitation sum, the southern part of Gobi-Altai and Bayankhongor provinces receive less than 50 mm; north-west, south, south-east of Gobi-Altai province, south of Bayankhongor province, south of Umnugobi province, west of Dornogobi province and east of Khovd province receive 50-100 mm of precipitation; center and north-east of Bayan-Ulgii province while north and center of Khovd province and center of Dornod province receive 100-150 mm of precipitation. Along the foothills of Altai mountains, Kharkhiraa, Turgen, Khan-Khukhii and Khangai mountains, the gap between the steppe-desert zones receive 150-200 mm of precipitation makes 15.4 percent of the total territory; the top of the Altai mountains and slopes of Khangai, Khuvsgul, Khentii, Khingan mountains receive 200-250 mm of precipitation making 17.7 percent; the gap from Khangai, Khuvsgul and Khentii slopes to the cap receive 250-300 mm of precipitation making 12.2 percent; the most of the Khangai, Khuvsgul, Khentii cap receive 300-350 mm of precipitation making 8.0 percent of total territory and the Khuvsgul and Khentii mountain areas that receive less than 350 mm making 5.8 percent of the total territory.

Wind: Since the country has vast valleys, narrow gorges that have varying depressions as well as depressions that are surrounded by mountains from different sides, the direction and speed of the wind are greatly dependent on them. The dominant wind direction extends from the north-west to north-east and the wind repetition in this direction reaches 20-60 percent. The wind speed increases from the north to the south and while the annual average reaches 1-2 m/s in the north, in gobi regions it reaches 4.0-4.9 m/s and 6.0 m/s in spring. By using the wind resource map of Mongolia, the wind with 2 m/s speed takes 15.5 percent of the territory or mostly east side of Altai mountains (windbreak); Darkhad depression, Khangai mountain lap, forest windbreak is exposed to 2-4 m/s wind speed and the major mountainous areas such as Altai, Khangai, Khuvsgul and Khentii mountains take 36.2 percent of total territory; the area exposed to 4-6 m/s wind speed takes 17.5 percent while the area exposed to 6-8 m/s wind speed takes 19.2 percent and the wind speed of 8 m/s < in the gobi and steppe zones take 11.6 percent of the total territory.

Snow cover map (MODIS 2000-2013) The environmental studies determine the spatial distribution of the precipitation in general terms while it is quite complex to determine it in terms of surface conditions (elevation, direction, slope). However, it became possible to determine in which months the snow cover is formed and how it is changed or when it melts in which part of Mongolia by using the satellite information. Upon using the MODIS satellite

information, produced the 2000-2013 snow cover distribution data for every third 10th day of the month from the end of September or the time the snow starts falling until end of March or the time the snow melts. During 14 years, the snow cover distribution reached its maximum or snowed 82 times in some places. The snow cover was divided into following 5 categories. The areas with >5 times of snow repetition include south-east of Umnugobi and west of Dornogobi province or 6.1 percent of total territory; areas with 5-10 times of snow repetition include desert or gobi or 21.1 percent of total territory; areas with 20-30 times of snow repetition take 15.6 percent; areas with 30-40 times of snow repetition take 17.9 percent, and areas with 40 times of snow repetition take 27.6 percent of total territory.

4.1.2 Ecological unit slope of the ground surface: The elevation, aspect and slope of the surface are categorized and the following ecological unit slope of the ground surface has been developed. Upon consideration of the ground surface conditions, there were 64 categories.

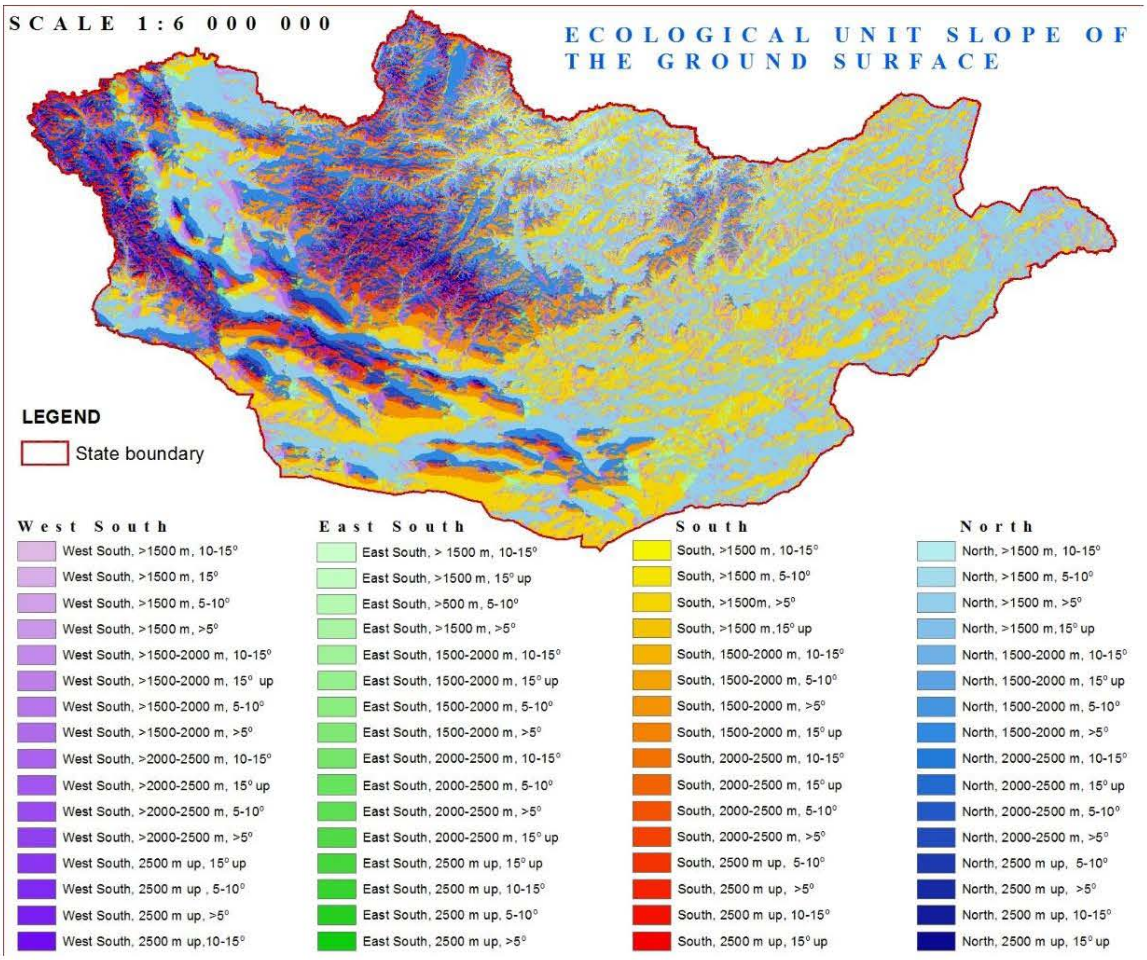

Figure 4 . Ecological unit slops of the ground surface

Table 2. Ecological unit slops of the ground surface

Unit surface number	The one elevation, the one aspect, the one slope	Unit surface number	The one elevation, the one aspect, the one slope	Unit surface number	The one elevation, the one aspect, the one slope	Unit surface number	The one elevation, the one aspect, the one slope
111	>1500 m, east south, > 5	211	1500-2000 m, east south, > 5	311	2000-2500 m, east south, > 5	411	2500 m < east south, > 5
112	>1500 m, east south, 5-10	212	1500-2000 m, east south, 5-10	312	2000-2500 m, east south, 5-10	412	2500 m < east south, 5-10
113	>1500 m, east south 10-15	213	1500-2000 m, east south,10-15	313	2000-2500 m, east south, 10-15	413	2500 m <, east south, 10-15
114	>1500 m, east south,15 <	214	1500-2000 m, east south,15 <	314	2000-2500 m, east south,15 <	414	2500 m <, east south, 15 <
121	>1500 m, south, > 5	221	1500-2000 m, south, > 5	321	2000-2500 m, south, > 5	421	2500 m <, south. > 5
122	>1500 m, south , 5-10	222	1500-2000 m, south, 5-10	322	2000-2500 m, south, 5-10	422	2500 m <, south, 5-10
123	>1500 m, south, 10-15	223	1500-2000 m, south, 10-15	323	2000-2500 m, south, 10-15	423	2500 m <, south, 10-15
124	>1500 m, south, 15 <	224	1500-2000 m, south, 15 <	324	2000-2500 m, south, 15 <	424	2500 m <, south, 15 <
131	>1500 m, west south, > 5	231	1500-2000 m, west south, > 5	331	2000-2500 m, west south, > 5	431	2500 m <, west south, > 5
132	>1500 m, west south, 5-10	232	1500-2000 m, west south, 5-10	332	2000-2500 m, west south, 5-10	432	2500 m <, west south, 5-10
133	>1500 m, west south, 10-15	233	1500-2000 m, west south, 10-15	333	2000-2500 m, west south, 10-15	433	2500 m <, west south, 10-15
134	>1500 m, west south, 15 <	234	1500-2000 m, west south, 15 <	334	2000-2500 m, west south, 15 <	434	2500 m <, west south, 15 <
141	>1500 m, north, > 5	241	1500-2000 m, north, > 5	341	2000-2500 m, north, > 5	441	2500 m <, north, > 5
142	>1500 m, north, 5-10	242	1500-2000 m, north, 5-10	342	2000-2500 m, north, 5-10	442	2500 m <, north, 5-10
143	>1500 m, north, 10-15	243	1500-2000 m, north, 10-15	343	2000-2500 m, north, 10-15	443	2500 m <, north, 10-15
144	>1500 m, north, 15 <	244	1500-2000 m, north, 15 <	344	2000-2500 m, north, 15 <	444	2500 m <, north, 15 <

Discussion: The geography of ecology determines the environmental resources at 3D spatial dimension. The geographical subdivision of ecology is to identify the territorial differences of the ecological unit slope and determine the horizontal and vertical spatial micro-climate indicators on it. By doing so, shall acquire the demarcation that is appropriate for the soil characteristics and plant species. Therefore, carefully conducting this research, firstly, demarcates the frontiers of the ecological unit slope and determines the soil-plant composition; secondly, demarcate the relevant territories that are appropriate for animal husbandry.

Gratitude: The fundamental approach of the research was developed upon the ecological methods, methodology and guidelines developed by Professor, (Sc.D) D.Bazargur as a result of his years of research and analysis. In addition, would like to extend our gratitude to B.Sainbuyan, researcher at the Division of Cartography and GIS, Institute of Geography and Geology and researchers of the sector.

Conclusion

Upon application of the satellite information for mountain exposition and animal husbandry research, studied the correlation between various types of images with high resolution as well as their mathematical correlation and following conclusion was reached.

By categorizing the elevation, direction and slopes of Mongolia, identified 64 different ecological unit slopes of ground surface. The micro-climate indicators on these 64 units of surface determined the years of average indicators. The mathematical correlation between the ecological unit slopes of ground surface as well as the ground surface temperature was 0.6 whereas, the correlation between the ecological unit slopes of ground surface and the wind speed was 0.44 or it will be more beneficial if further studies are conducted. The sum of the sunray received varies depending on the surface conditions, yet, as the surface height increases, the surface with more slopes and faces south, south-east or south-west will be exposed to more sunray; as the surface height and slope are opposite, the sunray decreases. It is proven by the sunray that hits the mountain peak and the last sunshine that shines on the mountain top. The mathematical correlation between the average sum of the sunray and the ecological unit slope of the ground surface is 0.8 or very high. The correlation between the ecological unit slopes of the ground surface and the snow cover is 0.5.

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