Drought Risk Area Match Evaluation between 2 Spatial Techniques include with Probabilistic Rainfall Surface: Weighted Map Layers Compete to TVDI Technique.

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KEY WORDS: TVDI method, Drought assessment, Probabilistic statistical surface, Rainfall kriging surface.

ABSTRACT: TVDI method and weighted map data from the relationship between land cover and NDVI are very interesting techniques for drought assessment. Meanwhile, the probabilistic, statistical surface of rainfall also be stand for very interesting factor. This study evaluates drought risk area of the use kriging surface of rainfall incorporate to "Method I; TVDI" and "Method II; weighted map data" with GIS process, then compare results together. Definitively, these two methods had shown the same drought risk area, according to the local base record data, while, the results of Method I shown very less swing than the results of method II. Hence, TVDI combine with rainfall kriging surface would be proper for drought risk evaluation technique. Absolutely results are described.

1. INTRODUCTION

Eastern part of Phitsanuloke province is standing for the study area. This area being in 2 districts as Chartrakarn and Nakorn Thai, which, according to high terrain, elevation sufficient to 250 – 800 meters from MSL. Our study area as signifies for the upper reach area of Kwae-noi River, which indicate main tributaries of the Nan watershed of Thailand. Additionally, the study area has drought problems in the summer time.

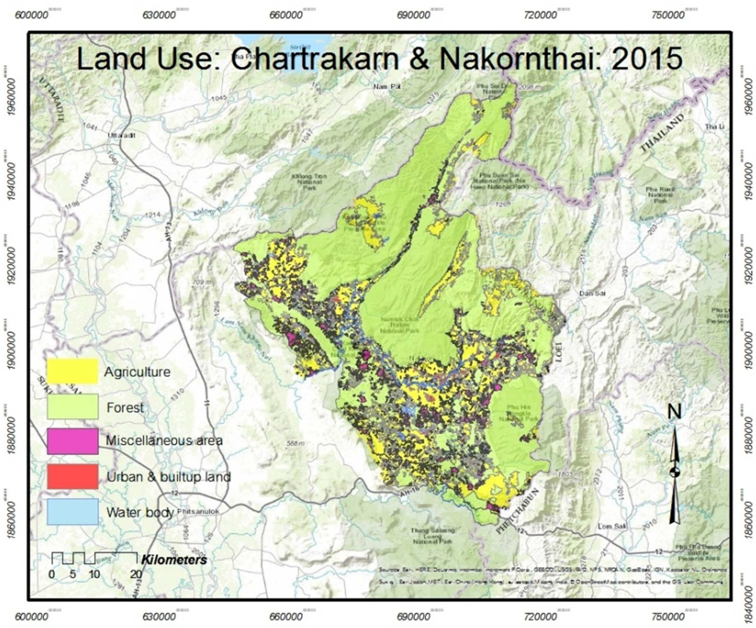

Figure 1 Study area: Landuse 2015.

2. OBJECTIVES

As statistical rainfall surface being the main factor. This study used 2 techniques for evaluates drought risk area, there are 1) TVDI method and 2) Weighted map data as related to NDVI, and distance from the main river.

3. RELATED MAIN CONCEPTS

3.1 The Normalized Difference Vegetation Index (NDVI)

NDVI is a numerical indicator that uses the visible and near-infrared bands of the electromagnetic spectrum, and is adopted to analyze remote sensing measurements and assess whether the target being observed contains live green vegetation or not.
The NDVI algorithm subtracts the red reflectance values from the near-infrared and divides it by the sum of near-infrared and red bands.

NDVI= (NIR-RED) / (NIR+RED)

Theoretically, NDVI values are represented as a ratio ranging in value from -1 to 1 but in practice extreme negative values represent water, values around zero represent bare soil and values over 6 represent dense green vegetation (Rouse et al., 1973, Holme et al., 1983 and Roderick et al., 1996)

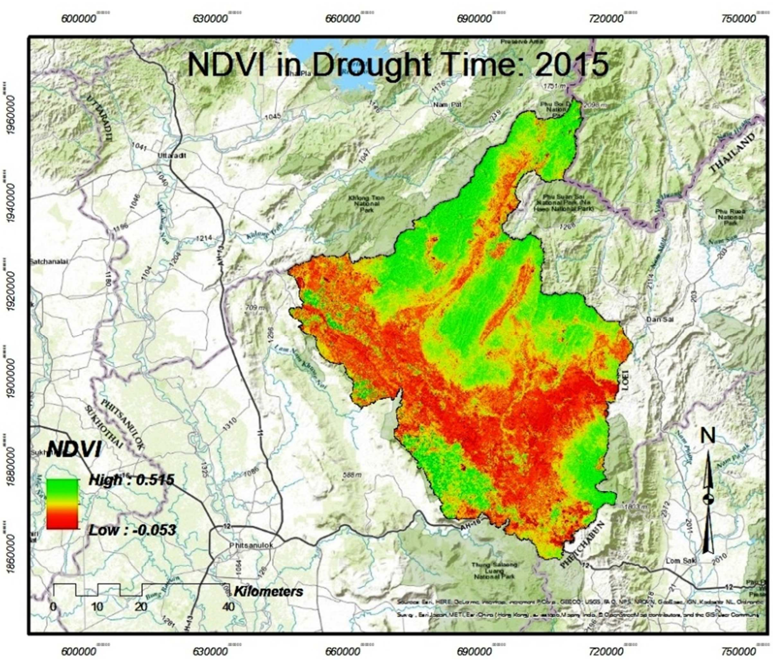

Figure 2 NDVI in drought time: 2015.

3.2 Land surface temperature (*LST* or *T*s)

Land surface temperature (*LST*) is generally defined as the skin temperature of the ground. For the bare soil surface, *LST* is the soil surface temperature; for the dense vegetated ground, *LST* can be viewed as the canopy surface temperature of the vegetation; and in the sparse vegetated ground, *LST* is determined by the temperature of the vegetation canopy, vegetation body and the soil surface.

LST is a very useful input for modelling energy balance components and mapping evapotranspiration (*ET*). Retrieval of *LST* using thermal IR bands of satellite images is the most effective way to derive energy balance and *ET* on a regional basis. The land surface temperature is an important factor controlling more physical, chemical and biological processes in the Earth (Parida and Oinam, 2008)

3.4 Kriging statistical surface

Kriging is a stochastic method for spatial interpolation. Typically, universal kriging incorporates a trend such as a trend surface equation in the kriging process.

$$\mathrm{M} = \mathrm{b}_1 X_i + \mathrm{b}_2 + Y_i$$

where M is the drift, X_i and Y_i are the X and Y coordinates of the known point i, and b_1 and b_2 are the drift coefficients to be estimated. Universal 2 incorporates a quadratic surface, which is defined by a second-order polynomial:

$$M = b_1 X_i + b_2 Y_i + b_3 X_i^2 + b_4 X_i Y_i + b_5 Y_i^2$$

The b_i coefficients in the polynomial equation must be estimated along with the weights. This means that universal kriging requires a larger set of simultaneous equations than ordinary kriging and a larger number of known points for estimating an unknown value (Borradail 2003; and Chang 2004).

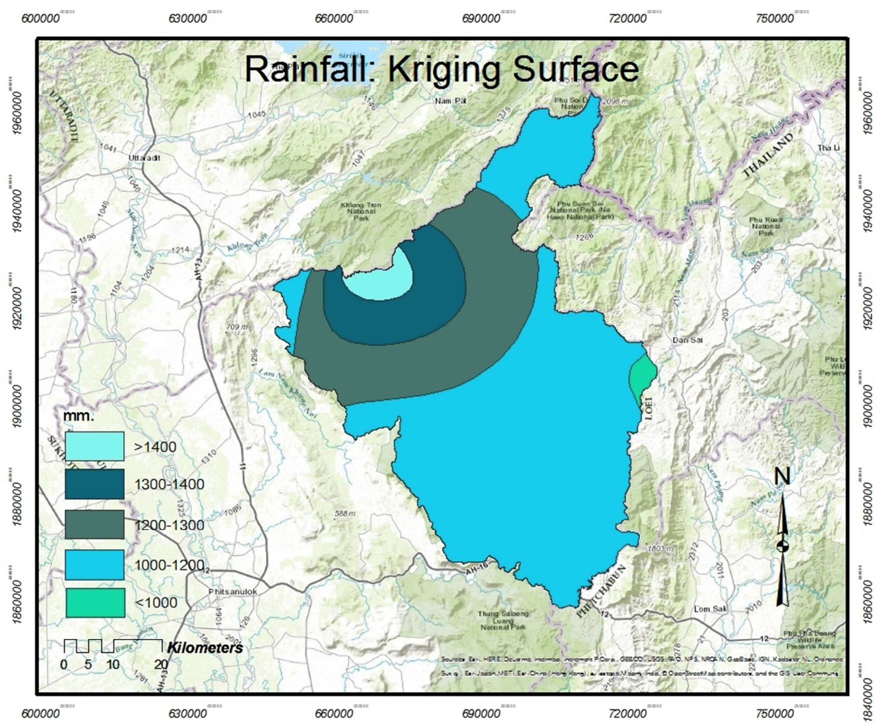

Figure 3 Rainfall kriging surface.

4. METHOD I; TVDI and METHOD II; WEIGHTED MAP DATA

4.1 Method I: TVDI

Temperature Vegetation Dryness Index (*TVDI*)

TVDI proposed by Sandholt *et al.* (2002), is a simple and effective method for regional drought monitoring. TVDI is obtained from Lower surface Temperature - Normalized Difference Vegetation Index (LST or Ts - NDVI). TVDI having the values of 1 at the ''dry edge'' (limited water availability) and 0 at the ''wet edge'' (maximum evapotranspiration and thereby unlimited water access).

$$\mathbf{TVDI = (LST - LSTmin)\ (LSTmax - LSTsmin)}$$

Where LST is the land surface temperature of every given pixel;

LSTmax =a1 + b1NDVI is the fitting equation of the dry edge, which is the observed maximum surface temperature corresponding to a given NDVI, whose theoretical soil water content should be "0";

LSTmin= a2 + b2NDVI is the fitting equation of the wet edge,which is the observed minimum surface temperature corresponding to a given NDVI, whose theoretical soil water content should equal to field water capacity.

Son et al (2012) referred to Wang et al (2004) proposed that TVDI values range from 0 to 1: TVDI = 1 at the dry edge, indicating no evaporation from the soil or limited moisture supply; and TVDI = 0 at the wet edge, indicating maximum evaporation from the soil or unlimited moisture supply. The TVDI is categorized into five classes describing drought conditions: wetness (0–0.2); normal (0.2–0.4); slight drought (0.4–0.6); moderate drought (0.6–0.8); and severe drought (0.8–1).

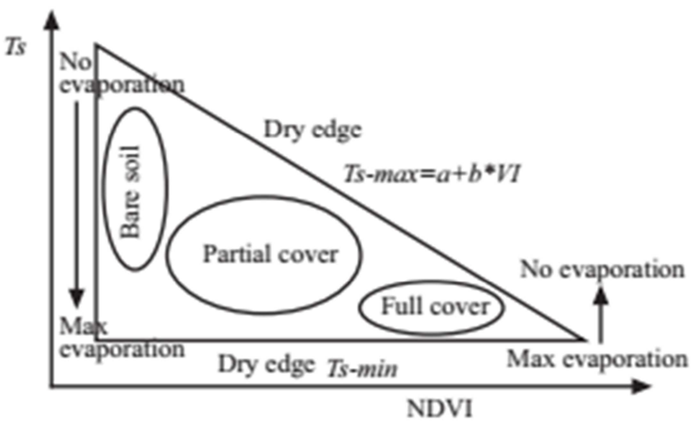

Figure 4 Simplified T_S / NDVI Space (Sandholt at al., 2002)

4.2 Method II: Weighted map data

For method II combined main related data for weighting; (i) Landcover and NDVI; (ii) Krigging statistical rainfall surface for 9 rain gauge stations and (iii) Buffer distance from the main river, as 2000 meters, 2000-4000 meters, 4000 – 6000 meters, and more than 6000 meters.

Rate of drought risk levels has been classified as five scores; severe, moderately, slightly, low, and very low, according scores are 5, 4, 3, 2, 1 respectively.

5. RESULTS AND DISCUSSION

5.1 Method I Results

With Landsat 5 data of drought time in April 2015, for examine drought risk area with the combination of TVDI and rainfall kriging surface at drought time in three months (December, January and February 2015), the highest area is slightly drought 27.94 % (1070 Km^2), later is moderately drought 27.42% (1050 Km^2), at least is wetness area 6.79% (260.13 Km^2)

Table 1. Drought risk form TVDI.

Drought Risk Classes	Area (Km^2)	%
Wetness (very low)	260.13	6.79
Normal (low)	616.62	16.05
Slightly drought	1,070	27.94
Moderately drought	1,050	27.42
Severe drought	855.22	21.80
Total	3,831	100

5.2 Method II Results

Rendering to rating of drought risk area from combination of land cover, ndvi, rainfall, and buffer distance from the main river, the highest area is severe drought 55.74% (2135 Km^2), later is moderately drought 27.85% (1067 Km^2), at least is very low area 0.14% (5.49 Km^2)

Table 2. Drought risk of Weighted map data

Drought Risk Classes	Area (Km^2)	%
Wetness (very low)	5.49	0.14
Normal (low)	75.01	1.96
Slightly drought	548.14	14.31
Moderately drought	1067	27.85
Severe drought	2135	55.74
Total	3,831	100

All results are according to the drought happening data of Phitsanuloke province as shown in 2013 – 2015. Furthermore, with different processes, Method I and Method II found different drought risk amount area, but have been correspondence places about the severe drought area, moderately drought area, slightly drought area and low drought area.

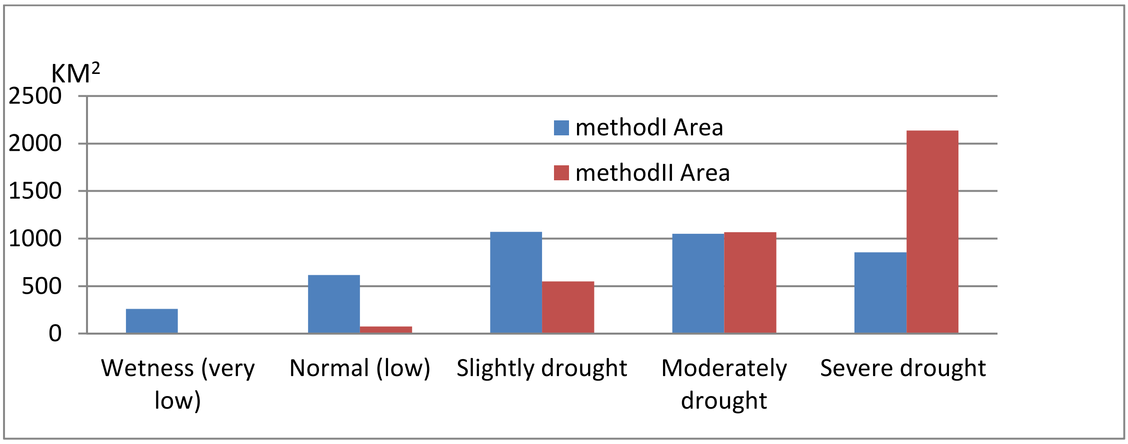

Figure 4 Comparison of Method I & Method II.

Method II signified more over severe drought as 55.74%, but the very low drought area just only exposed 0.14%. This outcome represented that method II has so more different and more swing when compares with metod I.

6. CONCLUSION

"Method I; TVDI" and "Method II; weighted map data" have comparable severe drought risk area.The distribution curve of the method I am shown less difference than the distribution curve of method II. All results can be the example for any researcher who would interest in drought analysis with Geo-informatics application. The combination of TVDI and rainfall statistical surface stand for very interesting Spatial Geo-informatics tools for analyzes drought risk area. Finally, that would be the interesting experiment for any researcher to use anymore difference statistical surface of rainfall data to blend with TVDI for the classified drought risk area in any difference climate area.

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