Spatial variability of soil salinity and its influence on rice yield in salt-affected areas using remote sensing techniques

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ABSTRACT Soil salinity has become one of the major constraints to sustain crop production in Myanmar, especially in the dry zone areas. This study aims to monitor the distribution of soil salinity and its influence on yield and chlorophyll content of rice by using remote sensing techniques. This study was conducted in the salt-affected soils at Myittha Township, the central dry zone of Myanmar during the rainy season of 2019. Sentinel-2 satellite imagery was used in the analysis for vegetation index (VI) at three different growth stages of rice. The results showed that the distribution of soil salinity was varied from 2.0-7.6 dS/m. The significant relationships were found between rice plant chlorophyll content and the VI values under different salinity levels. A relationship was also observed between NDVI and rice grain yield. Identifying the spatial distribution of salinity stress using the spectral vegetation indices would be beneficial for rice production and thereby allow for decreasing soil salinity in the salt-affected areas.

Keywords Salinity, Sentinel-2 satellite imagery, vegetation index

INTRODUCTION

Rice (*Oryza sativa* L.) is the most important food crop for more than half of the population of the world. It is cultivated over 167 million hectares with the production of 780 million tonnes. Crop productions are affected by many climatic and environmental factors, which can be abiotic and biotic factors. Salinity problems by water logging is relatively increased by rising the ground water level to increase the salt concentration at soil surface through evaporation that favors by high temperature with low rainfall in the dry zone areas of Myanmar.

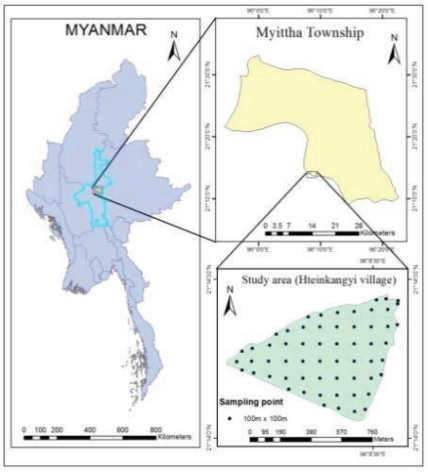
OBJECTIVE

This study aims to monitor the distribution of soil salinity and its influence on yield and chlorophyll content of rice by using remote sensing techniques.

METHODOLOGY

Site description

Geographically, the study site (salt-affected areas) is located between 21°14' 16.36"N latitudes and 96° 8'23.88"E longitudes in Hteinkangyi village, Myittha Township, Mandalay region, Myanmar. Elevation of the study site ranged from 106 to 111 m above sea level. The total area of the study site is 40 hectares. The study site has been affected by salinity for 20 years.



Data collection

Electrical conductivity using a Field Scout direct soil EC meter, rice grain yield, chlorophyll content, and image acquisition from Sentinel-2 Satellite at three different growth stages were collected during the rice growing season of 2019.

Data analysis

Soil salinity and yield maps were produced using inverse distance weighting (IDW) in ArcGIS 10.7 software. Normalized difference vegetation index (NDVI) was calculated using the following formula (Rouse et al., 1974).

NDVI= (NIR - red / NIR + red)

RESULTS AND DISCUSSION

Spatial variability of soil salinity and rice grain yield

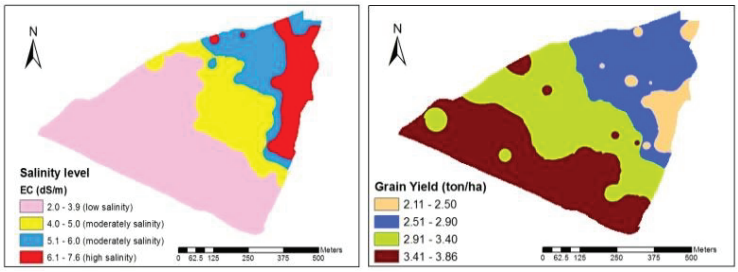


Figure 1. Spatial distribution map of electrical conductivity (EC) and grain yield

Chlorophyll content in rice

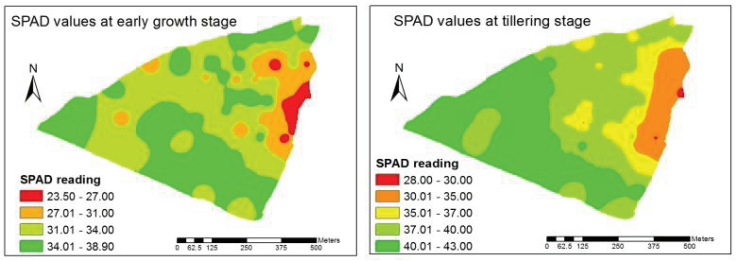


Figure 2. Spatial distribution map of chlorophyll content of rice in 2019

Vegetation index (VI)

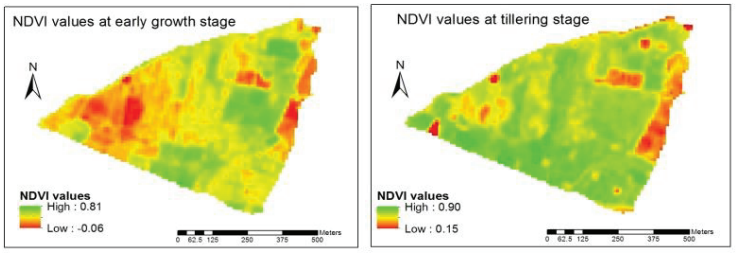


Figure 3. Normalized difference vegetation index (NDVI) values in 2019

Table 1. Relationships between yield and EC and reflectance of rice in 2019

Variable	Regression equation	R^2	d.f
Yield vs EC	y = -0.2675x + 4.2106	0.67 **	60
Yield vs Chlorophyll content	y = 0.1032x - 0.8945	0.44 **	60
Yield vs NDVI at tillering	y = 2.9802x + 0.9379	0.31 **	55

** – significantly different at P≤0.01

CONCLUSION

The distribution of soil salinity varied from 2.0-7.6 dS/m in the study area. Significant relationships were found between rice grain yield and chlorophyll content and NDVI values, whereas negative correlation was found between yield and EC.

ACKNOWLEDGEMENTS

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REFERENCE

Rouse et al., 1974. "Monitoring the vernal advancements and retro-gradation (green wave effect) of natural vegetation. Greenbelt", MD: NASA.