# Remote sensing ecological index evaluation in Samara, Russia

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**Abstract**

For sustainable development of a region, ecological evaluation is necessary because recently ecology has been degraded day by day due to extreme exhaustion of natural resources and high rate of human-socio-economic activities. A methodology was generated with principal component analysis (PCA) approach for remote sensing ecological index (RSEI) based on dryness, greenness, moisture, and temperature indicators by using Landsat satellite data in the Samara region, Russia from 2010 to 2020. Results were indicate the overall ecological condition was improved in this decade, where improved ecology characterized by high natural resources, while degraded ecology associated with high human-socio-economic activates. This research work is a baseline for real time accurate ecological mapping, monitoring, management, decision making and sustainable development.

**Keywords**
RSEI, satellite remote sensing, principal components analysis, land surface parameters

## 1. Introduction

In this decade ecological condition is degraded continuously due to extreme exploitation and miss-use of natural resources [1]. Currently high rate of disturbance and human pressure on natural resource create un-stability in ecology, which make different fragile ecosystems, environment and climate change [2]. A regional ecology depends on local land surface phenomena such greenness, dryness and when these basic parameters comes under stress condition than whole ecology comes in vulnerable situation and further effect on environment [3]. So in a healthy environment, ecological vulnerability is a balance situation in between natural resources and human pressure. Therefore a study of ecological evaluation is necessary for conservation, preservation, management, sustainable development and planning of a region [4].

## 2. Materials and methods

Samara region, Russia chooses as a study area. Landsat TM/ETM+/OLI/TIRES images were used for this research work, which was collected from United States of Geological Survey (USGS) for the year of 2010, 2015 and 2020. All radiometric, atmospheric and geometric errors were removed in ArcGIS software and all images were projected in WGS-1984-UTM zone-39N projection at 30 m resolution.

## 3. Methodology

Moisture, greenness, dryness and heat are the basic parameters which influence the ecology later on environment or climate change and these parameters are directly relevant to human-socio-climate factors. Therefore this research work generates remote sensing ecological index (RSEI) based on dryness, greenness, heat and moisture from Landsat images at the pixel level and try to cover *human-socio-climate* factors to accurately ecological evaluation measurements.

## 4. Results and discussion

The RSEI conditions in agriculture and open field/areas were first increased from 2010 to 2015 and then decreased from 2015 to 2020 around 1500 km$^2$ (10%) area. In city and small town as well as in the high socio-economic activities areas in first half RSEI was decried but later on in second half it was increased (26.9.77 km$^2$, 17.61%) because now government give special attention in these sites such as making gardens and plantations. Normally changes in vegetation or greenness due to *human-socio-economic* activities can relate to built-up area expansion and LST patterns. Therefor government should make laws related to control built-up area sprawl under rapid urbanization to achieve the goal of sustainability. As the overall continuously decreasing area was very less which means samara administration trying to maintain good ecological conditions in the state with sustainable development.

## 5. Conclusions

A new real time RSEI index was developed from satellite data in PCA approach based on regional parameters so resulted maps are reflection of regional ecological situation. Results indicate that in first half ecological condition was improved and in second half it was degraded but overall in this decade it was improved. Extreme weather condition and human-socio-economic activities were the main effecting factor for the change in ecology. Due to using RS/GIS technology this study is useful as a multi-spatiotemporal analysis for any other study area at any scale for ecological mapping and monitoring.

## 6. Acknowledgements

## 7. References

[1]    Boori, M.S. Comparison of hyperspectral and multi-spectral imagery to build a spectral library and land cover classification performances / M.S. Boori, R. Paringer, K. Choudhary, A. Kupriyanov // Computer Optics. – 2018. – Vol. 42(6). – P. 1035-1045. DOI: 10.18287/2412-6179-2018-42-6-1035-1045.

[2]    Ali, M. Ecological study of Juniperus phoenicea L. in EL-Gabal El-Akhdar area, Libya / M. Ali, S. El shatshat // Euro. J. Exp. Bio. – 2015. – Vol. 5(7). – P. 71-76.

[3]    Qureshi, S. A Remotely Sensed Assessment of Surface Ecological Change over the Gomishan Wetland, Iran / S. Qureshi, S.K. Alavipanah, M. Konyushkova, N. Mijani, S. Fathololomi, M.K. Firozjaei, M. Homaee, S. Hamzeh, A.A Kakroodi // Remote Sensing. – 2020. – Vol. 12(18). – P. 2989.

[4]    Tsaur, S.H. Evaluating ecotourism sustainability from the integrated perspective of resource, community and tourism / S.H. Tsaur, Y.C. Lin, J.H. Lin // Tourism Management. – 2006. – Vol. 27(4). – P. 640-653.