

Feasibility Study for the Estimation of the Chlorophyll-a Using ASTER Data in an Eutrophic Lake, Sri Lanka

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The objective of this study is to evaluate the performance of the previously proposed band ratio approach in estimating Chl-a in Bolgoda Lake, Sri Lanka as a representative example of Case II waters. Lake is located at western province in an area with lot of industries and also with some agricultural activities. Considerable amount of industrial effluents are discharged into it. Illegal filling and also encroachment has occurred in the recent past. This study focused on to determine the trends in eutrophication via Chl-a changes during the recent past, make predictions and recommend mitigatory measures and suggest precautionary measures to restore the environment. From March to December 2013, water samples at 5 points of Lake were collected once per month parallel to ASTER overpass and Chl-a of each sample was measured using a laboratory spectrophotometer. Cloud-free ASTER scenes acquired over Lake under clear sky conditions were selected during 2000 to 2013 for Chl-a estimation and trend analysis. All the ASTER images were atmospherically corrected using FLAASH and in-situ Chl-a data on Lake were regressively analyzed with atmospherically corrected three ASTER VNIR band ratios such as B1/B2 of the same date. Finally, the regression equation of the band ratio with highest correlation (B1/B2; $R^2 = 0.78$) was used to develop algorithm for generation of 15-m resolution Chl-a distribution maps using atmospherically corrected time series satellite imageries in day by day basis. This method applied for ASTER band 1/2 ratio due to Chl-a is positively correlated with the green band reflectance and negatively correlated with the red band reflectance. Therefore, the reflectance ratio of green and red bands becomes a robust parameter to estimate the Chl-a content. According to the ASTER based Chl-a distribution maps it is clearly evident that eutrophication of the Bolgoda Lake has been gradually increased from 2005-2011. Further, results showed that there were significant eutrophic conditions throughout the year 2013 in several parts of the Lake and considerable spatial heterogeneity with higher concentrations being recorded water stagnant areas and in water adjacent to freshwater outlets. It is clear that Bolgoda Lake is apparently a disposal site of various discharges of factories in addition to poor drainage and sewage systems present in this area. Highly unplanned urbanization and absolutely lack of adequate waste disposal management facilities in industries close to Lake have resulted in pollution of water. If the present trend of waste disposal and unplanned urbanization continue, they would create enormous environmental problems in future. Results of the present study showed that information from satellite remote sensing can play a useful role in determining the changes in Chl-a related to eutrophication in Bolgoda Lake and in the development of time series Chl-a distribution maps. Such information is important for the future predictions, development and management of this area as well as in the conservation of biodiversity. Therefore we recommend incorporation with this technique for routine monitoring of water quality using multi satellite data such as ASTER in inland water bodies like Bolgoda Lake in the future.

Keywords: Chlorophyll-a, Remote Sensing, ASTER, Sri Lanka, Bolgoda Lake