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AN OVERVIEW OF REMOTE AND PROXIMAL SENSINGS FOR EUTROPHIC STATE ESTIMATION OF LAKES

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A summary of comprehensive report to be presented to the Ninth United Nations Regional Cartographic conference for Africa, November 11-15, 1996.

By Gezahegne Gebremeskel

ETHIOPIAN MAPPING AUTHORITY

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REMOTE AND PROXIMAL SENSINGS OF EUTROPHIC STATE ESTIMATION OF LAKES

Summary

Lakes, including both exorheic and astatic which are alimented by centripetal drainage, are repositories for a myriad of nutrients. Nutrient influx is one of the major causes of eutrophication.

Eutrophication. is a process in which natural or man-induced nutrients are funneled into a lake via surface wash as leacheates or stream channels to the effect that, the physical, chemical and biological structures of the lake show qualitative changes.

Objective. The objectives of this paper are itemized as follows.

- The process of persistent eutrophication in Ethiopia is one of the most pervasive pollutants of the Rift lakes, but it is familiar only to a narrow circles of limnologists, physical geographers and environmentalists. In view of this, it appears to be imperative to make the concerned institutes better aware of the fate of the Rift lakes;

- To popularize the technical approaches for evaluating the eutrophic status(productivity) of lakes. Although there are conventional methods and techniques, the main intention of this study is to introduce the potential use of remote sensing using satellite raster data of high pixel depth and proximal sensing using grating-spectro-radiometer;

- To assess the impact of eutrophication on birds, fish and park animals;

- To propose remedial measures which can mitigate chronic natural and anthropogenic stresses, so that the pristine lacustrine ecosystem is maintained.

THE TECHNICAL APPROACHES USED

The eutrophic status of a lake can be estimated by a number of technical approaches. Some of the methods usually employed involve sampling followed by laboratory analysis. The other approach is the Carlson's Trophic Status Index(TSI). The TSI requires in situ data measurements. This includes the following.

- Firstly, the transparency of a lake by Secchi disk;
- Secondly, Chlorophyll-a(Cyanophyta's) presence of sampled data by photometric analysis;
- Thirdly, total phosphorous presence through 'Ascorbic method analysis'.

The results of these measurements are later used as inputs for Carlson's empirical formulae. After the computation, values less than 40 are classified as oligotrophic (sterile) lakes. Values between 40 and 60 are classified as mesotrophic (moderately nourished) lakes. Values above 60 are classified as eutrophic (productive) lakes.

So long as the study's main intention is to popularize two vital proposals, high emphasis is given to remote and proximal sensings.

Proximal sensing. Non-imaging spectro-radiometers scan target reflectance and provide data in the form of a profile for the subsequent parametric analysis. Grating spectro-radiometer so far has been used in land use/cover and forestry to detect chlorosis and senescence i.e, yellowing and decreased infrared reflectance of leaves, either due to disease or toxic intakes and age respectively. In this study, the proposal is based on the possibility of mounting a grating spectro-radiometer on a boat for recording reflectance data due to algal presence in Lake Abijata. Lake Abijata is one of the quartet lakes some 250 km south of the capital, Addis Abeba. The grating spectro-radiometer data which spans from 368.4 nm to 1113.7 nm has given a wealth of information pertinent to the eutrophic state (productivity) of the lake.

Remote sensing. Digital image processing of satellite raster data of high pixel depth like Landsat TM and SPOT XS provides valuable information concerning phytoplankton reflectance. Almost all of the vegetation indices which are being used to discern terrestrial green from dry biomass are based on the ratioing of visible and infrared bands. Although terrestrial healthy green vegetation and aquatic, especially algae, show similarity in the

absorption of the blue and red spectra from the photosynthetic active radiation (PAR), they exhibit a marked difference in the reflected spectra. Terrestrial healthy green vegetation strongly absorbs the red and blue spectra from the PAR (0.38 μm to 0.72 μm) and show a high infrared with medium green reflectance. However, in eutrophic lakes, aquatic, especially algal crop, reaction to the incoming photosynthetic active radiation is quite different.

Except for Oscillatoria from Cyanophyta and Navicula from the genera Chrysophyta, algae on the whole, absorb the red and blue spectra with peak green and medium infrared reflectance. Based on this, an algorithm was prepared by ratioing two visible bands, i.e, green and red.

After the eutrophic state estimation of Lake Abijata, the analysis treats the merits and demerits of eutrophication. Eutrophic lakes in Ethiopia have been providing fish for local consumption. Eutrophic lakes have become crocodile nursery centers, thus generating hard currency by providing crocodile leather for export. They are also habitats for aquatic animals and feeding and nesting places for pelicans, flamingos, cormorants etc,. Therefore, such aesthetic values have a very large tourist attraction.

Hypereutrophication, however, imparts stress on the phyto and zoo-plankton, birds and park animals. The impacts of eutrophication on the biological oxygen demand (BOD) and chemical oxygen demand (COD) are presented. These to the greatest extent have helped to suggest tenable reasons as to why eight bird and some fish (especially Tilapia) species disappeared from Lake Abijata. Moreover, the result of the study is possible to extrapolate it to the rest Rift lakes and the same phenomenon may be the reason for periodic mass zebra death at the Nech Sar National Park, which is adjacent to Lake Abaya. Eutrophication is the main factor for water hyacinth (Icornia crassipes) invasion of the Rift lakes of Ethiopia. The meliorative suggestions, if properly applied, would help to reinstate the pristine ecosystem of lakes.

CONCLUDING REMARK

This remote and proximal techniques of lacustrine productivity case study was conducted in Lake Abijata. A similar experiment was done in Lake Shalla. In both experimental studies, satisfactory results were achieved. In the future, similar tests would be carried out in the rest of the Rift lakes to check the validity of the proposed techniques. If analogous results are attained, the techniques would be considered as tenable and may be used for studying other lakes elsewhere in the world.

N.B.

This case study is, an abridged report on the potential use of remote and proximal sensings for the detection of lacustrine productivity. For the full technical report, containing the detailed analysis, the Ethiopian Mapping Authority may be contacted.

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