

CHANGE DETECTION OF LAKE ABA SAMUEL IN ETHIOPIA

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ABSTRACT:

Old topographic map published in 1975 elaborated from aerial photographs taken in 1972, Landsat TM data acquired in May 1986 and Landsat ETM+ from June 2002 have been used to assess the changes of the lake Aba Samuel in Ethiopia. First map of the lake has been done in the framework of UNDP project running in 1988-90 in the Ethiopian Mapping Authority. The second classification map has been done as M.Sc. thesis in the MUT in 2015. Supervised classification methods with the use of ground truth data have been used for elaboration of the Landsat TM data. From the year 1972 up to 1986 the area of the lake has decreased by 23%. From 1986 up to 2002 the area of the lake has decreased by 20%. Therefore, after 30 years the lake was smaller by 43%. This has had very bad influence on the lives of the local population. From other recent data in the period from 2002-2015 the lake has practically disappeared and now it is only a small part of the river Akaki. ENVI 5.2 and ERDAS IMAGINE 9.2 have been used for Radiometric Calibration, Quick Atmospheric Correction (QUAC) and supervised classification of Landsat ETM+ data. The Optimum Index Factor shows the best combination of Landsat TM and ETM+ bands for color composite as 1,4,5 in the color filters: B, G, R for the signature development. Methodology and final maps are enclosed in the paper.

1. INTRODUCTION

The lake is close to the capital Addis Ababa in Ethiopia and is about 2000 m above sea level. Optimum Index factor of Landsat TM data for creating of color composite have been calculated. The best one was: band 5 – Red filter, band 4 – Green filter and band 1 with Blue filter. Two sample of color composites is shown in Fig.1.

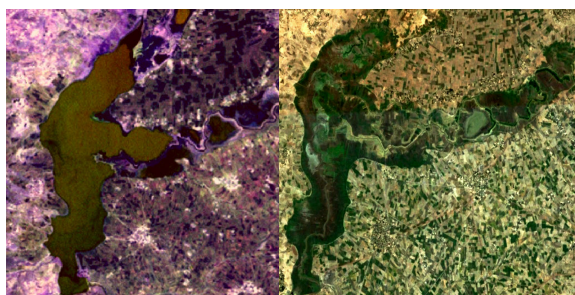


Figure 1. False color composites for Landsat 1986 (left) and 2002 (right)

2. METHODS

Supervised classification have been done using TM bands: 1, 4, 5, 7. Scatograms of the classes for chosen TM bands is shown in Fig. 2. Category “Water lily” on the surfaces of the lake recognized in 1989 is shown in Fig.3.

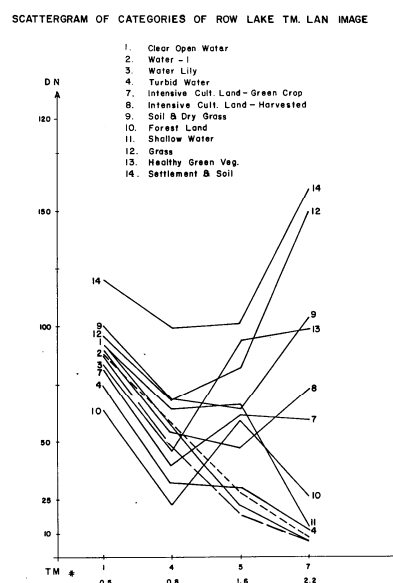


Figure 2. Scatograms of land cover classes for TM bands 1, 4, 5, 7



Figure 3. Water lily on the surfaces of the lake in June 1989

Classified map have been geometrically corrected using coordinates of the points from topographic map in the scale of 1:50 000 in UTM coordinate system. Accuracy has been checked on independent check points and $RMSX=RMSY=0.9$ pixel which is less than 30 m in the field. Four classes of water were detected. A part of the classified map superimposed on the topographic map 1:50 000 scale is shown on Fig. 5. Results of comparison of area of the lake in years from 1972 to 1986 is shown in Fig. 4. This pilot project has been done within the framework of UNDP/DTCD project ETH/86/040 in Ethiopian Mapping Authority using ERDAS software running in DOS and was presented to the decision makers in Addis Ababa at the Seminar in 1989.

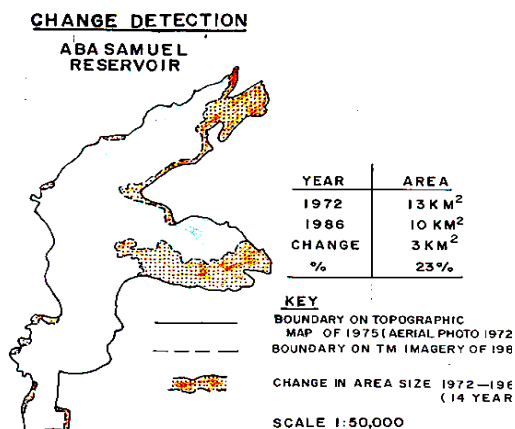


Figure 4. Results of comparison of area of the lake in years from 1972 to 1986

The second raw ETM + data (5 bands) taken in June 2002 have been corrected using software ENVI 5.2: Radiometric Calibration and Quick Atmospheric Correction (QUAC). A few methods for change detection have been tested and supervise classification was the best one. ERDAS IMAGINE 9.2 have been used for supervised classification of ETM+ Landsat data. The results of change detection in period 1986 – 2002 are shown in Fig. 6. The lake has been changed – 43 % for the period from 1972 to 2002.

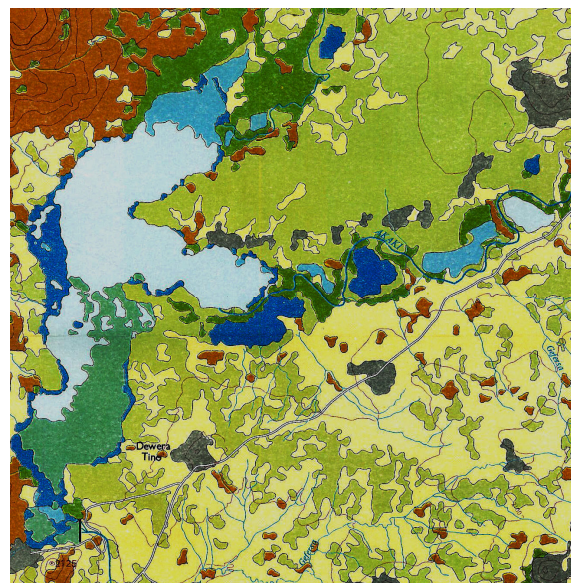


Figure 5. A part of land cover map in scale 1:50 000 with superimposed contours line

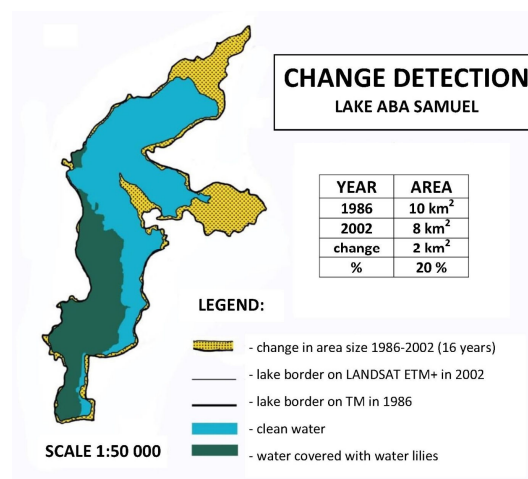


Figure 6. Changes from 1986 to 2002



Figure 7. Lake ABA Samuel in 2015
[<https://earthexplorer.usgs.gov>]

3. RESULTS

	Landsat TM		Landsat ETM+	
	ha	%	ha	%
Clear water	537,5	3,8	180,0	1,6
Two classes of turbid	337,6	2,4	328,4	4,8
Water lily	250,0	1,7	285,4	4,7
Shallow	17,8	0,1	24,4	10,1

Table 1. Results of classification Landsat data of Lake Aba Samuel in 1986 and 2002

4. CONCLUSIONS

The results of the above study on the basis of Landsat data clearly shows the rapid devastation of the water environment in Ethiopia. It is the responsibility of the local authorities to undertake preventive measures.

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