A MULTICRITERIA APPROACH FOR THE SUSTAINABLE MANAGEMENT OF THE PLASTIRAS RESERVOIR, GREECE

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1. Introduction

The Plastiras Lake, situated in a mountainous part of Western Thessaly (Figures 1 and 2), is a multipurpose reservoir used for hydropower, irrigation, water supply and recreation. These competitive uses raise various conflicts between groups of different interests (farmers, residents, ecologists, hotel owners).

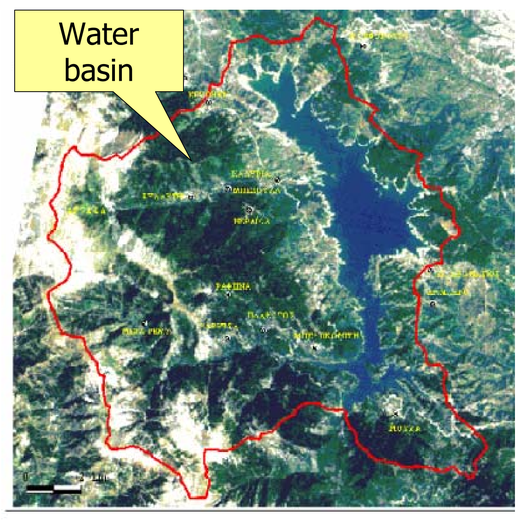


Figure 1: Satellite image of the Plastiras Lake and its basin

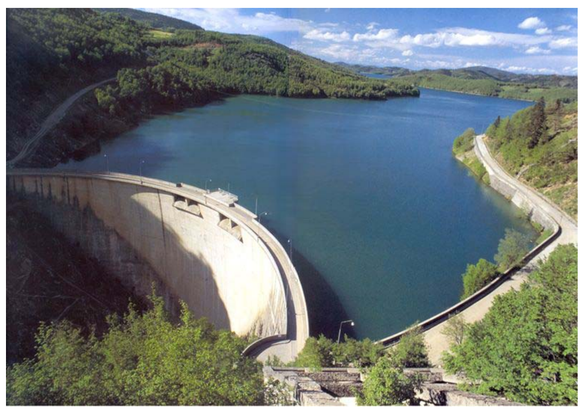


Figure 2: Panoramic view of the southern part of Plastiras Lake

Until recently, no attempt was made towards rational management of the Plastiras Lake. On the contrary, annual water release, mainly targeted at irrigation, was directly related to inflow, a policy which is not optimal on the long run. Moreover, the range of level variation exceeded 12 meters, affecting both the landscape (due to the appearance of a transition area without any vegetation) and water quality.

2. Characteristics of the water basin and the reservoir

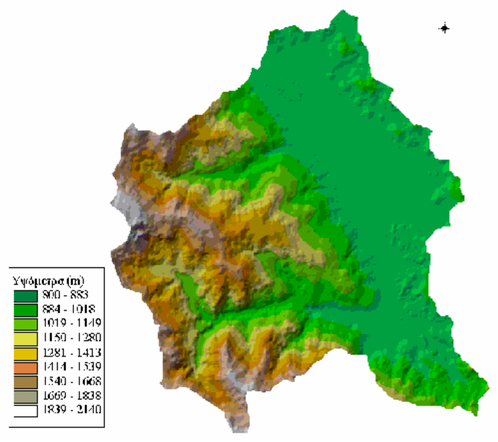


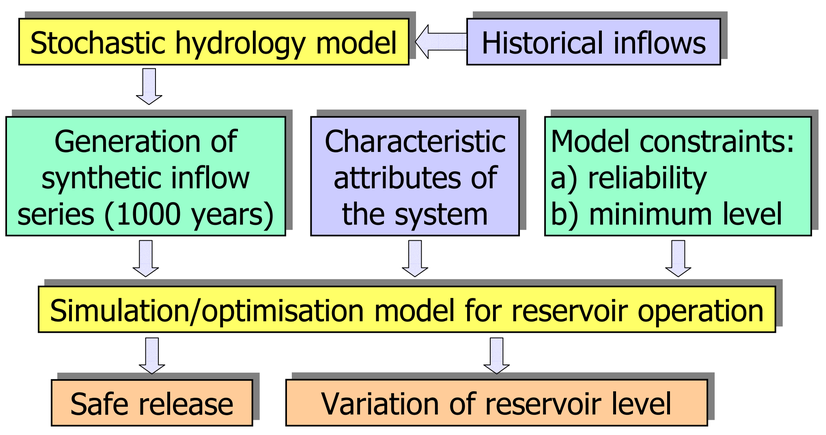
Figure 3: Digital terrain model of the basin

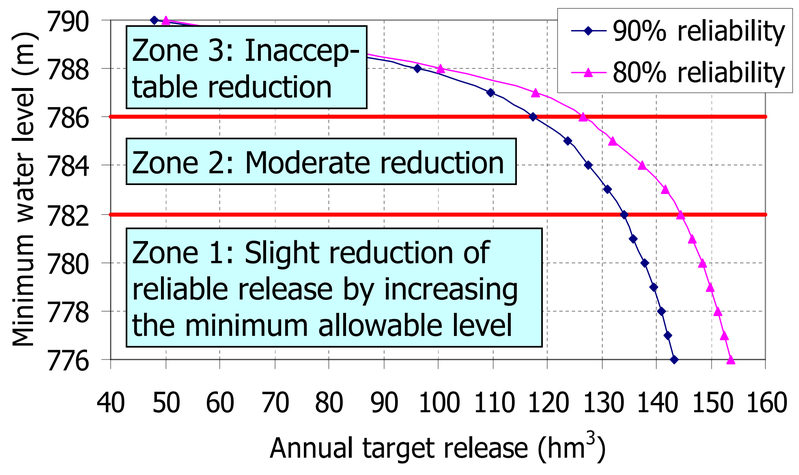
- Basin area 161.3 km^2
- Maximum basin altitude 2140 m, mean altitude 1459 m
- Mean annual runoff 147 hm^3 (1029 mm)
- Arch dam, height 83 m
- Reservoir capacity 362 hm^3, net capacity 286 hm^3, maximum area 25 km^2
- Intake level +776 m, spill level +792 m
- Installed power capacity 130 MW hydraulic head 577 m
- Annual water demand 160 hm^3 (145 hm^3 for irrigation, 15 hm^3 for water supply)

3. Scope and methodology

A multidisciplinary approach was attempted, aiming at determining a rational and sustainable management policy for the reservoir. This consists of establishing a **minimum allowed water level**, in addition to a **constant annual reliable release**. Three types of analyses were employed, by means of minimum allowed level scenarios, to assess the variation of the corresponding criteria as a function of the reservoir level: (a) reservoir operation analysis, (b) water quality analysis, and (c) landscape analysis.

4. Reservoir operation analysis through a stochastic simulation approach





5. Water quality analysis

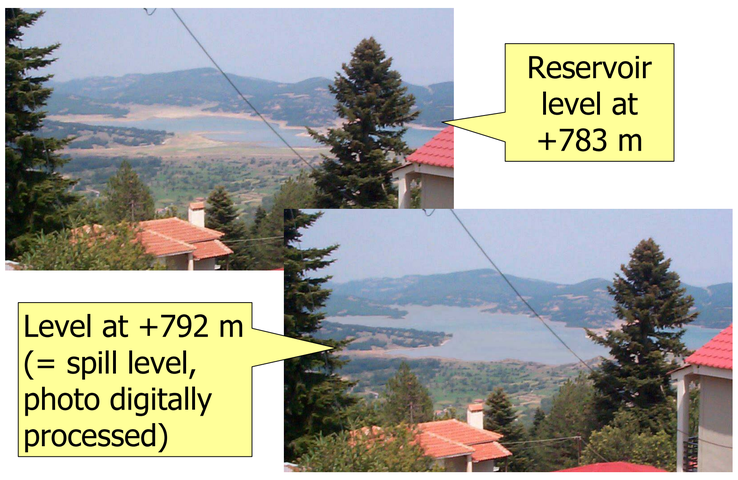
Methodology

- Selection of characteristic minimum level scenarios (+780 to +786 m), using the historical inflows and the simulated outflows for a specific 5-year drought period (1989-1994).
- Assessment of pollutant loads (from point and non-point sources).
- Simulation of various water quality parameters (with emphasis in chlorophyll-α and DO), with two models: (a) a 2D hydrodynamic model, and (b) a 1D eutrophication model.
- Model calibration using in-site measurements.

Main results

- All available water quality data, chemical and biological, indicate that the lake is still not polluted and can be classified as oligotrophic.
- Chlorophyll-α concentrations ranged from 0.7 to 3.7 mg/L, indicating low values of primary production
- No signs of DO hyper-concentration due to eutrophication were observed.
- For minimum level up to +786 m the water quality is classified as "excellent", whereas for lower levels it is classified as "very good".

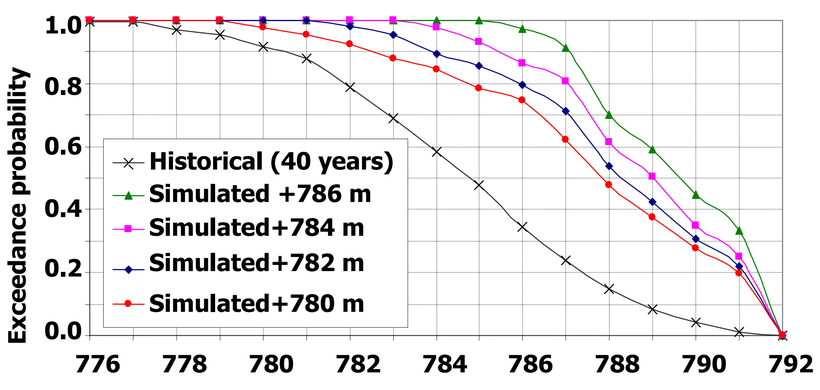
6. Landscape analysis

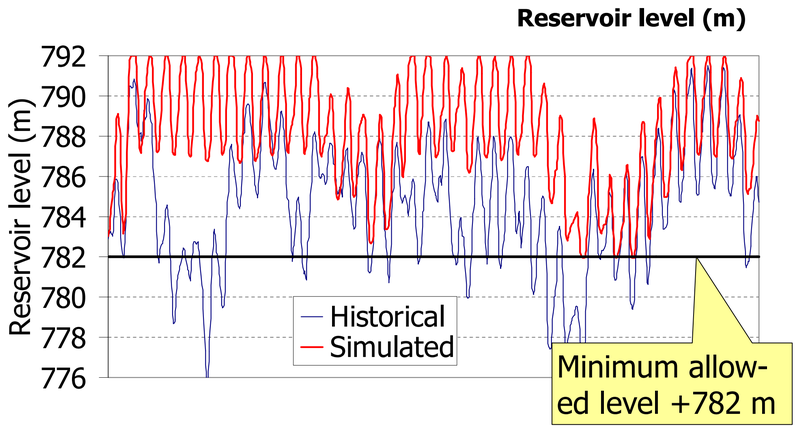


Aesthetics assessment through questionnaires

- **High level** (+786 to +792 m): The landscape degradation is minimal or totally absent and all observers find it wonderful.
- **Medium level** (+782 to +786 m): The landscape degrades as the reservoir level drops. Most casual observers find it beautiful, whereas regular observers anticipate some problems but are generally satisfied.
- **Low level** (+776 to +782 m): The landscape is seriously degraded. Only casual observers find it satisfactory and only in certain locations.

7. Investigation of level fluctuation





8. Setting up a multicriteria tableau

Minimum allowed level (m)	Safe release (hm^3/y), 90% reliability	Time distribu-tion of level & classification	Water quality class
+780	137.9	7% Bad 8% Fair 12% Good 27% V. good 46% Excellent	II
+782	134.0	8% Fair 11% Good 28% V. good 53% Excellent	II
+784	127.5	10% Good 29% V. good 61% Excellent	II
+786	117.3	26% V. good 74% Excellent	I
+788	96.3	100% Excellent	I

9. Conclusions

- 784 m has been selected as the minimum allowed level, with a recommendation of keeping 786 or more.
- 90% has been selected as the reliability.
- The annual yield is 127 hm^3.
- In failures (once every ten years on the average), the minimum allowed level will be maintained; the release will be reduced.