UNIVERSITÀ DEGLI STUDI DI MILANO

FACOLTÀ DI STUDI UMANISTICI

Restoring Lake Varese: Addressing Eutrophication and Ecological Challenges for Sustainable Revival

Andrea Celoria

Human Science of Environment, Landscape and Territory, University of Milan, Milan, Italy
January 2025, Academic year 2024/2025
Professor Ripamonti Francesca

Abstract

This project focuses on the ecosystem of Lake Varese, the challenges it faces, and the solutions to address them, analyzing current outcomes. It includes a historical and geomorphological overview of Lake Varese, the industrialization phase that led to a critical environmental situation, and the implementation of various measures to begin cleaning the lake's waters. Finally, it examines key issues regarding the feasibility of intervention, highlighting that while it is not an easy task—given the high costs and potential risks—it is essential to understand the importance of restoring the lake's waters. The study primarily employs quantitative methods, some of which are direct, facilitated by materials provided by the president of the association. My interest in this topic stems from my regard for nature, and as a resident near Lake Varese, I have always sought to explore this issue in depth. Furthermore, this study aims to identify viable solutions for restoring the lake's waters as effectively as possible.

Keywords: *Lake, Pollution, Wastewater, Sewerage, Ecosystem.*

Glossary: ***Pollution****: is an alteration of the environment, whether natural or man-made, by pollutants.* ***Eutrophication:*** *the eutrophication of a lake is a process characterized by the excessive accumulation of nutrients, especially phosphorus and nitrogen, causing algal blooms, hypoxia and loss of biodiversity.* ***Collector circumlacual****: a collector collects waste water along the lake, conveying it to the water purifier.* ***Sewerage****: is a system of pipes that collects and disposes of sewerage and rainwater to prevent pollution.* ***Hypolimnion****: the hypolimnion is the deep, cold layer of a lake, with low oxygen and where the accumulation of nutrients and gases is most concentrated*

1. Introduction

The "Save Lake Varese" project, initiated in 2019, is the brainchild of Austrian activist and long-term resident of Italy, Dorothea Dietz. The primary objective of the project is the ecological restoration and rehabilitation of Lake Varese, with the aim of making it once again suitable for swimming and public access. Lake Varese, together with Lake Comabbio, has historically been one of only two non-bathing lakes in the province of Varese, an area renowned as the "province of the seven lakes," which also includes Lake Maggiore, the second largest lake in Italy. This paper will examine the geomorphological characteristics of the lake, the sources and impacts of pollution, as well as the ongoing restoration efforts and the status of the lake's water quality. One of the key resources referenced will be an interview with Dorothea Dietz, the founder of the "Save Lake Varese" initiative. The primary objective of this report is to restore the lake's water quality, making it swimmable once again, to preserve the ecosystem and promote tourism in the area.

1.1 Background

I chose to do this research project because I come from the province of Varese and I live in a very small-town bordering Lake Varese, called Bodio Lomnago. Moreover, the leader of this initiative, Dorothea Dietz, is my neighbor. Austrian by birth, but a resident of Italy for almost fifty years, she

has always been a strong environmental activist. However, since living here, she has never been able to swim in the lake and launched this initiative because, being originally from Austria, both in Austria, Switzerland and Germany, they have managed to restore lakes that had suffered from pollution problems due to industrialization, the same main issue that has affected this lake.

1.2 Statement of the problem

One of the seven lakes in the province of Varese, Lake Varese is a lake of glacial origin in the foothills of the Pre-Alps, known for the discovery in 1863 of pile-dwelling remains dating back to the fifth millennium BC, which became a UNESCO World Heritage Site in 2011, together with the 'Prehistoric Pile Dwellings around the Alps'. Until the 1950s, the lake was known for its clean and swimmable waters. However, from that time onwards, the first signs of environmental degradation began to appear: algae proliferation, change the water color and fish die-off, quickly leading to the lake being declared unfit for swimming in the 60s. The main cause of this deterioration was the inadequate management of wastewater, with sewage discharges from neighboring municipalities directly discharging polluted water into the lake, favoring the phenomenon of eutrophication. This process occurs when an excess of nutrients, mainly phosphorous and nitrogen from urban and industrial discharges, acts as a fertilizer in the water, stimulating an uncontrolled growth of bacteria, particularly cyanobacteria. The rapid proliferation of these organisms alters the color of the water and creates a layer of slime on the surface, drastically reducing the amount of available oxygen and compromising the aquatic ecosystem.

Another contributing factor to eutrophication has been pollution caused by human waste, a widespread phenomenon in many lakes and rivers. As reported by Beatrice Barra, journalist for 'Ohga!', this pollution was aggravated by the belief that the lake, like other natural bodies of water, possessed a self-cleaning power, due to the presence of micro-organisms capable of degrading pollutant molecules and restoring the natural balance. This erroneous belief led to the neglect of the need to develop an efficient sewage system, disregarding the increase in population and the intensification of the industrialization process.

Despite the Varese Lake growing environmental crisis and the complaints of fishermen, the authorities have been slow to intervene due to a lack of adequate laws. It was only in 1974 that Lombardy introduced regulations on discharges, but technical complexity and conflicts of interest hindered effective action, leaving the lake only partially restored after decades.

1.3 Purpose of the study

The purpose of this study is to analyze all the methods and funds used by the association, together with the cooperation of the towns bordering the lake, to collect scientific and chemical data aimed at improving the environmental situation, with the main goal of making it swimmable again, as it once was.

1.4 Research questions

During our analysis, we have focused on the following questions to make the research more targeted and comprehensive:

1) How did the "Save Lake Varese" association starts and what does it do?
2) Where is the problem of cyanobacteria particularly prevalent?
3) Why is it important to clean the lake?
4) What tools are being used to clean Varese Lake?

1.5 Objectives of the project

The project seeks to investigate the underlying dynamics influencing the environmental health of the lake, with the objective of formulating effective strategies for its preservation. Utilizing advanced scientific instruments, comprehensive research materials, detailed analytical charts, and the latest available data, the initiative aims to identify and address critical threats to the lake's ecosystem. Moreover, the project takes in the development and recommendation of innovative solutions designed to enhance water quality and promote sustainable development. This rigorous analysis is intended to actively engage local communities, raising awareness and promoting a collective commitment to the conservation of this vital natural resource.

2. Review of the literature

In this project, I utilized various documents and research sources to gather information and insights. One of the primary references is an article published in the nature-focused magazine "*OhGa!"*, which provides an in-depth overview of the history and challenges associated with biodiversity in the region. Another significant source is a bachelor's thesis titled *"A Cross-Temporal Analysis of Environmental Rehabilitation Policies: The Lake Varese Case,"* which examines the lake's situation, with a particular focus on the tools and measures employed for its rehabilitation. Additionally, I analyzed content from the official website of the "Save the Lake Varese" association, which outlines the organization's key characteristics, main objectives, and numerous articles about the lake available in both Italian and English. A substantial portion of the research material was also directly provided by Dorothea Dietz, whose expertise and interest in this issue have been invaluable to the study.

3. Methodology

The approach used for this methodology was mainly quantitative, as the text is mainly based on data and statistics. In addition, the quantitative methodology adopted is a direct one, as a large part of the sources and data was collected directly by the reference person. However, the use of a qualitative methodology is also not ruled out, as for some information it was necessary to resort to online sources for specific research.

4. Data Analysis and Results

4.1 The "Save the Lake" association and the mains goals

This association was founded in 2019 by Dorothea Dietz, together with vice-president Alessandra Busnardo and secretary Giovanni Pinesso. It is recognized as an *Associazione di Promozione Sociale* (APS), a type of non-profit organization under Italian Law. The main goals of the association are to restore the lake for swimming, improve the sewage system, share research findings, raise public awareness, and promote collaboration nationally and internationally. Dorothea's commitment is inspired by her Austrian roots, where lakes are highly valued as key natural resources, and by the successes of neighboring Switzerland, which has restored many lakes and rivers to excellent ecological conditions.

4.2 Presence of phosphorus and its problems

The health of a lake is contingent upon the presence of various chemical elements, among which phosphorus is particularly significant due to its role in pollution and eutrophication. As highlighted by the President (Dorothea Dietz), a lake is considered to be in optimal condition when its phosphorus concentration remains below 20 micrograms per liter. In the Paleozoic era, phosphorus levels were around 8 micrograms per liter. However, by the 1960s, this concentration had risen to approximately 450 micrograms, by reporting severe pollution. This increase can largely be attributed to extensive waste disposal, particularly industrial effluents, stemming from the establishment of numerous factories in the lake's proximity, including a major white goods factory by the Ignis brand (now part of Whirlpool Corporation). In addition, the presence of a poorly designed water purification plant, situated near the lake, has contributed to the deterioration of water quality. Despite several investments, the plant continued to be ineffective in adequately treating the water. Another contributing factor to the lake's declining condition was and still is the discharge of animal waste, which is rich in phosphorus. This, coupled with other factors, facilitates the proliferation of cyanobacteria. The situation has been further exacerbated by the growth of numerous farms around the lake, which increases the influx of organic pollutants.

4.3 The Importance of Lake Cleaning to Safeguard the Ecosystem

As documented by Ms. Dietz, during the 1960s, when Varese Lake reached its most critical phase of pollution, many institutions exhibited a marked indifference to the severity of the situation, showing little inclination to implement remediation measures. Similarly, a significant portion of the local population remained apathetic to the environmental crisis. Among the few individuals who expressed genuine concern there was Salvatore Furia, a poet and meteorologist well-known in Varese for founding the Campo dei Fiori Prealps Astronomical Observatory. Mr. Furia was qualified in identifying

the alarming level of 450 micrograms of phosphorus per liter in the lake's water by collecting a sample himself. In 1977, Mr. Furia took a stand by pouring the contaminated lake water into the fountain at Piazza Montegrappa as part of a public protest aimed at raising awareness. This gesture garnered considerable attention. Furthermore, in the 1970s, a pivotal legislative measure was enacted - the 1976 Merli Law - which marked a significant turning point in environmental policy, as it prohibited the discharge of polluting chemicals, including those affecting lakes. From the late 1970s onwards, there was a notable increase in institutional attention towards the restoration of Lake Varese, and for the first time, relevant authorities began to be engaged in concrete actions to address the lake's environmental degradation.

4.4 Tools to be used to restore the waters of Lake Varese

Both internal and external measures were implemented to enhance the water quality of Varese Lake, which has been significantly impacted by industrialization and urbanization. While some temporary improvements were observed, comprehensive environmental rehabilitation has not been attained. The policies enacted yielded limited long-term success in addressing the lake's environmental challenges.

4.4.1 Urban sewerage diversion system

A critical component in the environmental management of Varese Lake is the implementation of a circumlacual sewer system encompassing the 16 municipalities surrounding the lake, complemented by the establishment of a centralized wastewater treatment plant. In the 1980s, the first comprehensive rehabilitation initiative was undertaken, involving the development of two primary collector networks (one in the northern and the other in the southern area of the lake) designed to channel wastewater directly to the central treatment facility in Gavirate. While initially effective, achieving a 68% reduction in phosphorus load within the lake, the system experienced progressive degradation in subsequent years. Hydraulic deficiencies, particularly in the southern section, led to the backflow of untreated water into the lake. This issue was exacerbated by factors such as population growth, expanded impermeable surface areas, and the proliferation of unauthorized sewer connections, ultimately undermining the efficiency and sustainability of the treatment infrastructure.

4.4.2 Hypolimnetic withdrawal

In response to the limitations of the circumlacual sewer system, it became necessary to accelerate lake restoration efforts using advanced technologies such as hypolimnetic withdrawal. This technique was specifically designed to remove phosphorus from bottom sediments, thereby reducing phosphorus concentrations in the hypolimnion and mitigating the effects of eutrophication exacerbated by summer thermal stratification. Between 2000 and 2003, the system successfully extracted 40 million m^3 of water, achieving a 30% reduction in phosphorus levels and contributing to an overall improvement in water quality. However, the initiative was discontinued after four years due to an unfavorable cost-benefit ratio, as the reduction in phosphorus was deemed insufficient relative to the operational costs. Additionally, the system posed environmental risks to the Bardello River and Lake Maggiore, which received the discharged material. The plant also generated unpleasant odors, attributed to its undersized capacity. Although the system is no longer operational, it remains in place, awaiting future reassessment.

4.4.3 Water oxygenation system

Along with the use of the Hypolimnetic withdrawal, the water oxygenation system was also implemented to counteract anoxia during the summer months of stratification. The intervention aimed to improve oxygen concentration to support the fauna and reduce phosphorus from the sediments, without disturbing the thermal stratification of the lake. The oxygenation system unfortunately failed to reduce anoxia due to the insufficient depth of the diffusers and was dismantled in 2004.

4.4.4 AQST program

The Region of Lombardy has launched an *AQST (Accordo Quadro Sviluppo Territoriale) 'Salvaguardia e recupero del Lago di Varese'* (Safeguarding and Restoration of Lake Varese) approach, divided into 6 MACRO-ACTIONS, covering a wide range of topics, from sewage system

management to public awareness. Each Macro-action is subdivided into several Actions, each composed of specific activities, with a co-ordinating entity responsible for execution and monitoring. Macro-Action A, deals with the improvement of the sewage system, Macro-Action B on water quality monitoring, Macro-Action C on hypolimnetic sampling, Macro-Action D on lake biodiversity preservation, Macro-Action E on communication and awareness-raising and finally the last Macro-Action F on pedestrian and cycling infrastructure.

5. Conclusions

Since 1960, Lake Varese has experienced significant improvements, attributed to increased public awareness and the closure of illegal sewer systems. In 2022, a historic swimming event across the lake was held, though participation remains limited. Despite these advances, phosphorus concentrations in 2019 were still measured at 125 micrograms per liter, well above acceptable thresholds. While certain areas of the lake are considered to meet standards, others, particularly near Gavirate, continue to face challenges related to sediment accumulation. The president of the associated organization underscores the need for sustained investment in the lake's rehabilitation, while also urging local communities to avoid further pollution.

References

- https://drive.google.com/file/d/15XSQLbA001c5ksndjDpOz33b_mKen2sR/view
- https://drive.google.com/file/d/1c3m8d1TzjbNX3Q-ZogkEZ_WhBV4EQ_w0/view
- https://it.wikipedia.org/wiki/Lago_di_Varese
- https://it.wikisource.org/wiki/L._10_maggio_1976,_n._319_-_Legge_Merli
- https://milano.fanpage.it/il-lago-di-varese-inquinato-e-non-balneabile-unaustriaca-lancia-uniniziativa-per-tutelarlo/
- https://www.mdpi.com/2073-4441/12/3/675
- https://www.ohga.it/varese-un-lago-da-salvare-per-lambiente-e-per-la-societa/
- https://www.radionumberone.it/podcast/beatrice-barra-lago-varese-tornera-balneabile-dopo-anni-inquinamento/
- https://www.regione.lombardia.it/wps/portal/istituzionale/HP/aqst-lago-di-varese
- https://www.regione.lombardia.it/wps/portal/istituzionale/HP/aqst-lago-di-varese/programma-d-azione
- https://www.regione.lombardia.it/wps/portal/istituzionale/HP/aqst-lago-di-varese/stato-del-lago
- https://www.savelakevarese.org
- https://www.savelakevarese.org/chi-siamo/
- https://www.savelakevarese.org/wp-content/uploads/2021/04/RCC-_Final-Project_SaveLakeVarese_C.Ram.pdf
- https://www.varesenews.it/2022/06/blitz-del-1977-le-acque-putride-del-lago-varese-finirono-nella-fontana-piazza-monte-grappa/1475414/