



Community response to the restoration of an urban lake

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THIS PAPER SHOWS how the community can be involved in the restoration program of an urban lake, exploring as example the case study of Pampulha Lake, Brazil. Since the recovery of urban water bodies is generally coupled with difficulties derived from the intense use and high susceptibility of these aquatic systems (Payne, 1986), it is of fundamental importance that the local community be involved as deep as possible in the complex task of implementation of restoration techniques. Pampulha Lake is actually a man made reservoir located within the urban area of the city of Belo Horizonte (3 million inhabitants). The lake was constructed originally with the objective of water supply, but the degradation of its water quality prevented the further use of this source as such. Presently Lake Pampulha, which is one of the most important touristic attractions of the region, is suitable only for some restricted recreational activities. The lake has an area of approximately 2,6 km² and a volume of about 14 million m³. Its maximum depth is 16 m and the drainage basin occupies the area of 97 km². The main sources of pollution are the discharge of untreated sewage (of domestic and industrial origin) into the lake and the strong erosion that takes place in the drainage basin. As a consequence of these impacts the water body suffers now from problems of eutrophication and siltation. The *eutrophication* is represented here by massive blooms of macrophytes as well as green and blue-green algae. Special attention is given to the possibility of toxin generation due to the algal metabolism, since the worldwide first reported deaths of human beings as consequence of production of algal toxins occurred in 1996 in the city of Caruaru, Brazil (Chorus and Bartram, 1999). With respect to the *siltation* it is estimated that around 400000 m³ of sediment are yearly transported to the lake.

Restoration program

Since the early 90's the local authorities implemented a broad restoration program, with the collaboration of specialists from the Federal University of Minas Gerais, including this author. The program is based on the adoption of *preventive* and *corrective* techniques for the rehabilitation of the aquatic system (Cooke et.al., 1993). Some of them have already been applied while others are still in the project phase. Examples of these measures are:

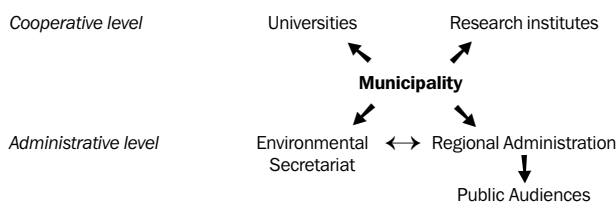
- **sewage diversion** in order to remove direct inputs of wastewater; in a first step about 9 km of interceptor lines were constructed around the lake;
- **urbanisation of slums** situated in the drainage basin;
- construction of a **new sanitary landfill** in the drainage basin;
- **hydroseeding** for erosion control: this technique was applied in about 30 erosion focuses situated inside the drainage basin;
- **macrophyte removal** : it refers specially to the removal of water hyacinth (*Eichhornia crassipes*), which had been growing very fast in the last years; we have learned in our practical experience in Pampulha Reservoir that about 20 per cent of the area covered by water hyacinths should be kept confined in the lake in order to establish a competition with the algae (after a prior complete macrophyte removal, that took place in 1989, a very strong bloom of cyanophytes was observed);
- **sediment dredging**: removal of over 3 million m³ of sediment by means of a suction dredger; the removed material has been directed (using plastic tubes) towards one of the entrances of the lake and deposited over a silted area, allowing in this way the creation of an ecological park, which will be used mainly for educational purposes; the monitoring of the dredging action showed that no resuspension of heavy metals from the sediment occurred. This concern is justified by the fact that the lake receives large amounts of industrial sewage with high contents of cadmium, chromium and lead;
- construction of **sedimentation basins** in order to avoid siltation problems in the lake; three basins will be constructed upstream the main entrances of the water body;
- construction of **pre-dams** in order to protect the lake from the loading of nutrients (von Sperling, 1996); the first pre-dam will be constructed upstream the main entrance of the lake;
- **precipitation of nutrients**: this technique could be applied in order to limit the nutrient input from non-point sources; the most probable choice will be the addition of aluminum sulfate or, eventually, iron chloride.

Community participation

Community participation is playing a striking role in the recovery process, since the success of the program depends on the achievement of several steps of environmental education. It should be noted that the population that lives around urban lakes has not only a very intensive visual

contact with the water body but also interacts with some uses such as recreation (swimming) and fishing.

The **administrative structure** of the restoration program is depicted below. It can be seen that the municipality is responsible for the program management, which includes the participation of universities and research institutes as a technical support. One important feature in the city organizational structure is the existence of 12 *regional administrations*. One of them corresponds to the area around Pampulha Lake. It is easy to understand that a regional administration can have a far more intense contact with the population, besides knowing extensively the problems of the region. On the other hand the citizen has an easier access to the regional administrator, eliminating hence all formalities and difficulties coupled with audiences with the mayor.



The **public audiences** are the main instrument for the citizen participation. The priority level of public works is defined according to the demands of the population, which are expressed through the convocation of public audiences. This sort of participative budget guarantees the optimization in the use of public funds. Several meetings have been organized in order to discuss pros and cons of investing financial resources in the complex task of restoring an urban lake. The majority of the inhabitants of Pampulha Lake district are strongly devoted to the implementation of restoring actions. There is a general consensus that a good environmental quality is closely linked with a good life quality.

The **income level** of the population that lives in the drainage area of Pampulha Lake is extremely variable. Near the shoreline the occupation is characterized by the prevalence of modern, large houses, together with clubs, churches and museums designed by the famous Brazilian architect Oscar Niemeyer, whose talented works are spread worldwide. At the borders of the drainage basin the dwellings are quite simple and not provided with an adequate sanitary infrastructure.

The process of **environmental education** for the community that lives in the drainage area of Pampulha Lake was based not only in prohibitions but rather in stressing the necessity of *change of values*. Pollution should be considered not just as an environmental impact but as an issue of social behaviour. A good example of this approach is related with the discharge of solid wastes in the tributaries

of the lake, which is a clear responsibility of each citizen. A TV sketch shows that “the same garbage you discharge in the river return to your home after flooding” and “what will your neighbour think about you if he sees how you dispose your wastes ?”

One important aspect in the environmental education process is related with **recreational activities**. Since the population is aware of the inconvenience of swimming in a polluted lake, the main leisure action is directed to **fishery**. An enquiry carried out by the Federal University of Minas Gerais showed that the absolute majority (about 95 per cent) of the fishermen are fishing not for leisure, but simply to obtain food. There is a clear incompatibility between using an aquatic environment as an indirect source of protein (eutrophic conditions) and maintaining its quality for recreational activities such as swimming, sailing and diving (oligotrophic conditions). Moreover the presence of snails in the shallow bays formed in the reservoir is a serious concern in respect to the transmission of **schistosomiasis**. It is interesting to observe that the reappearance of snails (*Biomphalaria glabrata*) is directly linked with improvements in the water quality, i.e. when the lake was more degraded the snails had no favourable conditions for their development. Another group exposed to schistosomiasis transmission is formed by people that extract **sand** from the sediments. This sand, in spite of being contaminated with coliforms and heavy metals, can be used for some restricted purposes, such as road pavement.

Finally the municipality and the regional administration stresses the point that the restoration of Pampulha Lake can not bring clear results in a short period of time. This **awareness of the existence of a lag time** is a noteworthy issue in order to avoid a future feeling of disappointment in the community.

Conclusions

The restoration of an aquatic system follows the way back to the situation prior to the existence of the main impacts that degraded its water quality. It is the return to a condition that many citizens, specially children and teenagers, can hardly picture in their minds. In the case of Pampulha Lake this change in the environment has been accomplished by the adoption of remedial interventions (preventive and corrective techniques) detailed in the paper. Besides the technical aspects, which are managed by the municipality, with support of universities and research centres, efforts are also directed to the informative issues. Thanks to the implementation of a regular monitoring program the community is following step by step the first changes that are happening in the lake: reduction of nutrient concentrations, improvement in transparency (Secchi depth) values, shift in plankton composition. It is like a friend or relative that has been ill and fortunately we can get clear answers to the question “How is he/she doing now ?”.

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