Regulatory Approach For Water Quality Protection In Chile

Key Aspects To Be Considered

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Abstract

Chile has been described as a land of contrasts, since this is one of the longest countries in the world, with territory from 17° S, above the Tropic of Capricorn to 56° S, almost reaching the Antarctic polar circle. This condition directly affects water management, being the most important issue for the northern regions its availability, in the central zone is the compatibility among different water uses, and in the southern extreme, its administration and the conservation of its quality.

Another specific condition of this country affecting environmental management of waterbodies is that environmental regulation is relatively new. This last situation also implies some handicap in terms of experience for building water quality standards. Nevertheless, the Chilean Regulatory approach for water quality management deserves a review, since it considers and interconnects at least four relevant issues: *a)* the standard itself, *b)* the monitoring, *c)* the evaluation and further action and *d)* the citizen's participation.

After ten years of environmental regulation, a water quality standard for an oligotrophic, southern lake was proposed for the first time. In this report, the most relevant aspects of the standard-setting process will be reviewed, focusing on the fact that a regulatory approach can serve as a ***preventive*** tool for lake's management.

Introduction

Chile is a developing country with a short history in environmental regulation. Only since 1994 has there been a specific environmental law and an institution created to coordinate environmental matters specified in this law and other environmental matters included in different regulations.

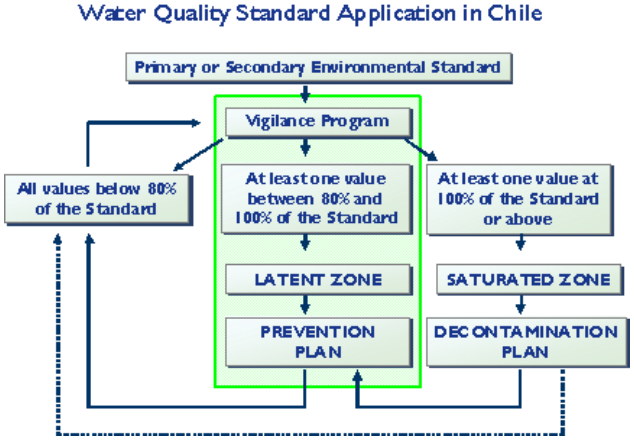
Chilean environmental law establishes what is denominated as the "Environmental Management System" for this country. This system included several "Management tools" such as Education and Research, Environmental Impact Assessment, Environmental Standards and Prevention and Decontamination Plans. In terms of Environmental Standards, there are three kinds of standards that can be established: Emission Standards, Primary Quality Standards (for human health protection) and Secondary Quality Standards (for environmental protection)

At present time, after fifteen years of this specific environmental regulation and institutionalism, the most developed and well known instrument is the System for Environmental Impact Assessment, and only a few environmental standards have been dictated and even fewer plans. Actually, only three Decontamination Plans have been developed and the three of them are made for urban air pollution.

When it comes to water management, three Emission Standards have been dictated since 1998: one for wastewaters discharged on sewage systems, another for wastewaters discharged on surface water (rivers, lakes and seas) and the last one for wastewaters discharged on groundwater. According to our regulation, Emission Standards do not generate Prevention or Decontamination Plans. This last management tool can only be activated when a Quality Standard is unaccomplished (Fig. 1).

In this scenario, during December 2004, for the first time in Chile, a water quality standard for a lake was proposed and finally accepted to be dictated as a Secondary Quality Standard. The process of establishment of this water quality standard has taken already more than four years and is not completed yet. A diagram showing the process and the three sweepstakes that must be completed before the actual application of a water quality standard in Chile is shown in Figure 2.

Figure 1: Diagram showing the preventive approach associated with a water quality standard.



This report is intended to exhort the use of water quality standards as a water quality management preventive tool, focusing on the relevance of monitoring, evaluation and further planning, based on the experience collected and lessons learned on the process of elaboration of a water quality standard for Lake Llanquihue in the south of Chile.

1. Knowing regulations and how they work.

Even when the elaboration of a water quality standard requires lots of technical approaches, they will finally be dictated as a regulatory instrument, so it is very important to understand the legislation and see if it promotes the kind or regulation that is being designed.

In this example, there is a virtuous connection between the National Constitution, the Environmental Law and the Standard itself that has served to impulse and promote its dictation.

The National Constitution, valid since 1980, establishes that every citizen has the Right lo live in an environment free of contamination, and that it is a responsibility of the State to guarantee this fundamental Right. Nevertheless, the term "contamination" was not legally defined, so it was highly difficult to determinate whether was, or not, actual contamination.

This situation changes when the Environmental Law was established in 1994, because this law finally defined the term contamination.

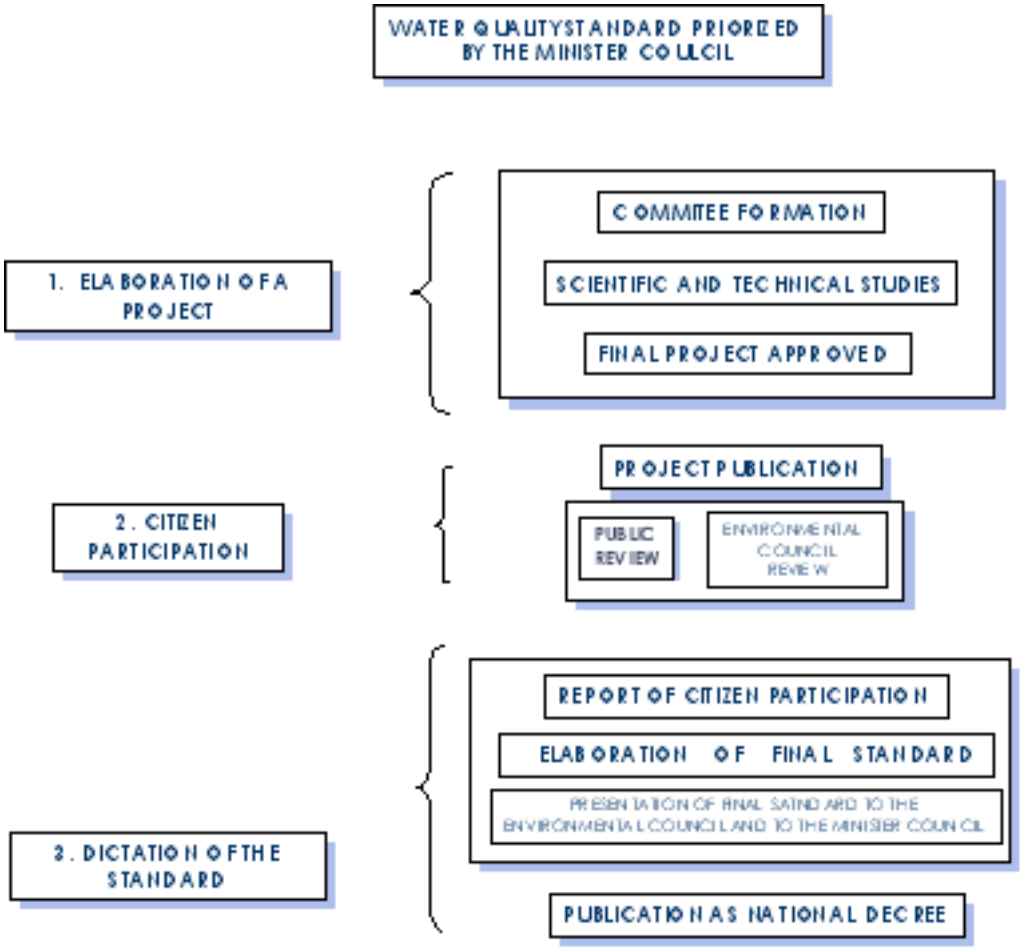
Unfortunately, the definition says that contamination is the presence in the environment of substances, elements, energy or the combination of them, in concentrations and permanence that are superior or inferior to what is established on the legislation.

This means, that there can only be contamination when a certain limit for substances, elements and/or energy is established by legislation. Simply said, *contamination is only possible when a standard is unattained, so, without a standard, there is no contamination at all.*

This last argument has been extremely useful to raise political and public interest on the process dealing with the water quality standard dictation, because when it is said in a very plain language, lake Llanquihue in Chile will never be contaminated unless it has a Standard (primary or secondary), dictated under the Environmental Law.

Figure 2: The three main stages of the establishment of a water quality standard

The process of establishment of a water quality standard has three main stages, being one of them the citizen participation. The establishment of a Plan also considers a citizen participation period.



Lesson No. 1: Know and understand if the legislative system supports (or not) a project for water quality management and build powerful and simple statements based on that.

2. Identifying relevant actors and coordinate understanding their expectative.

Chile's environmental Institutions do environmental management trough coordination. For the establishment of an environmental standard, at least two Committees shall be constituted and coordinated: an Operative Committee that actually creates the environmental standard, and an Extended Committee where different organization reviews and comments what the Operative Committee proposes.

This is a very constructive and synergetic way to build a proposal that can satisfy multiple interests, but to succeed on this, it is important to evaluate if all relevant actors have been considered and if there is an effective listening and processing of all opinions.

To start working with eclectic groups, the first step should be the establishment of a common language. For lake management, this is extremely important, because many limnological terms are known only by limnologists, economical concepts are known only by business managers and legal terms are known by regulators, and lake management involves all these matters and more. It is very useful investing time on having a common understanding of complex terms.

It is also important to dedicate time for expressing and listening everyone's expections and intentions. Assuming, therefore, the diversity, it is necessary to establish common objectives in general terms that can help to re-build consensus in further conflictive discussions.

After knowing what people think and expect, it is very easy to divide actors into supporters and detractors, according on the similarity of their opinions to our own. However, this might lead to omission of relevant issues presented as complaints or a divergent opinion. One way to improve coordination is trying to define different groups according to the main issues that people (or institutions) are trying to highlight. This will lead to a more constructive coordination and maybe to a more effective approach to Solving conflicts.

Lesson No. 2: "*Watchening*" (watch + listen) every opinion and make a more complex classification of them instead of "agree or disagree" will help a more constructive coordination.

3. Ensuring long-term and good quality monitoring.

After setting a water quality standard, many decisions based on the results of monitoring activities are made, so the quality of the data ensures the quality of decisions.

If the Chilean management system for environmental quality is converted into a conceptual model, as presented on

Figure 3: Diagram showing the relation established between legal, technical and decisional issues to give consistency to a regulatory approach for lakes management.

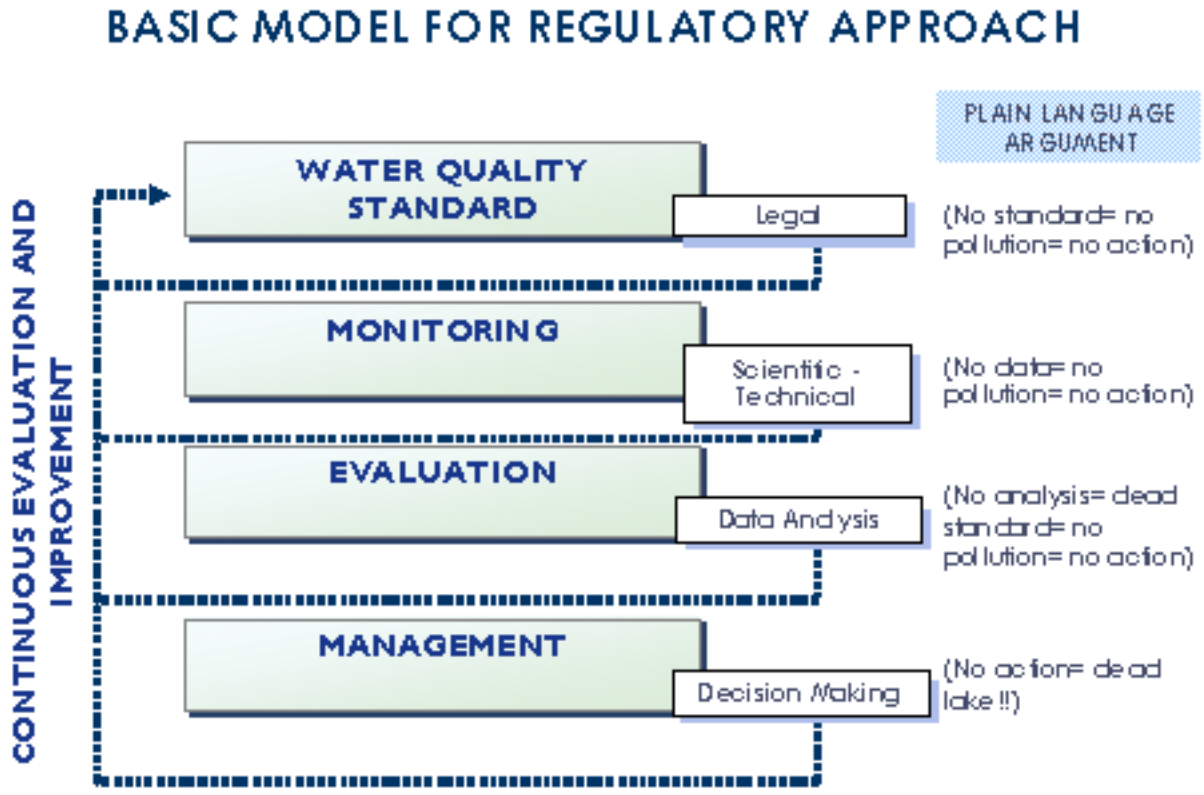


figure 3 , it is easier to understand the relevance of every component and how they need to be connected and supporting each other.

Nevertheless, monitoring has a very "key role" within the system since it provides the data that will be used for decision making, and for this purpose, management works just like a mathematic model: garbage in = garbage out.

It is important to understand that not all monitoring data is useful. It is strongly recommended to set up a "Monitoring Plan" specific for controlling a water quality standard and try not to use unreliable data, even if the values "look OK". This way, a set of rules can be fixed to accept water quality data presented by different actors/institutions to be used to control a water quality standard, specifically when the existing monitoring efforts are insufficient.

This idea of establishing a monitoring plan doesn't mean that new monitoring activities must be designed or implemented. Actually in Lake Llanquihue's case the proposal is to coordinate two National Authorities that actually conducts monitoring activities, but with different criteria. In this case, coordination should give as a result a monitoring plan, approved by these two authorities, specifying the monitoring station's location, the monitoring periodicity, the parameters that will be controlled, the monitoring and analysis techniques to be able to compare data, and so on.

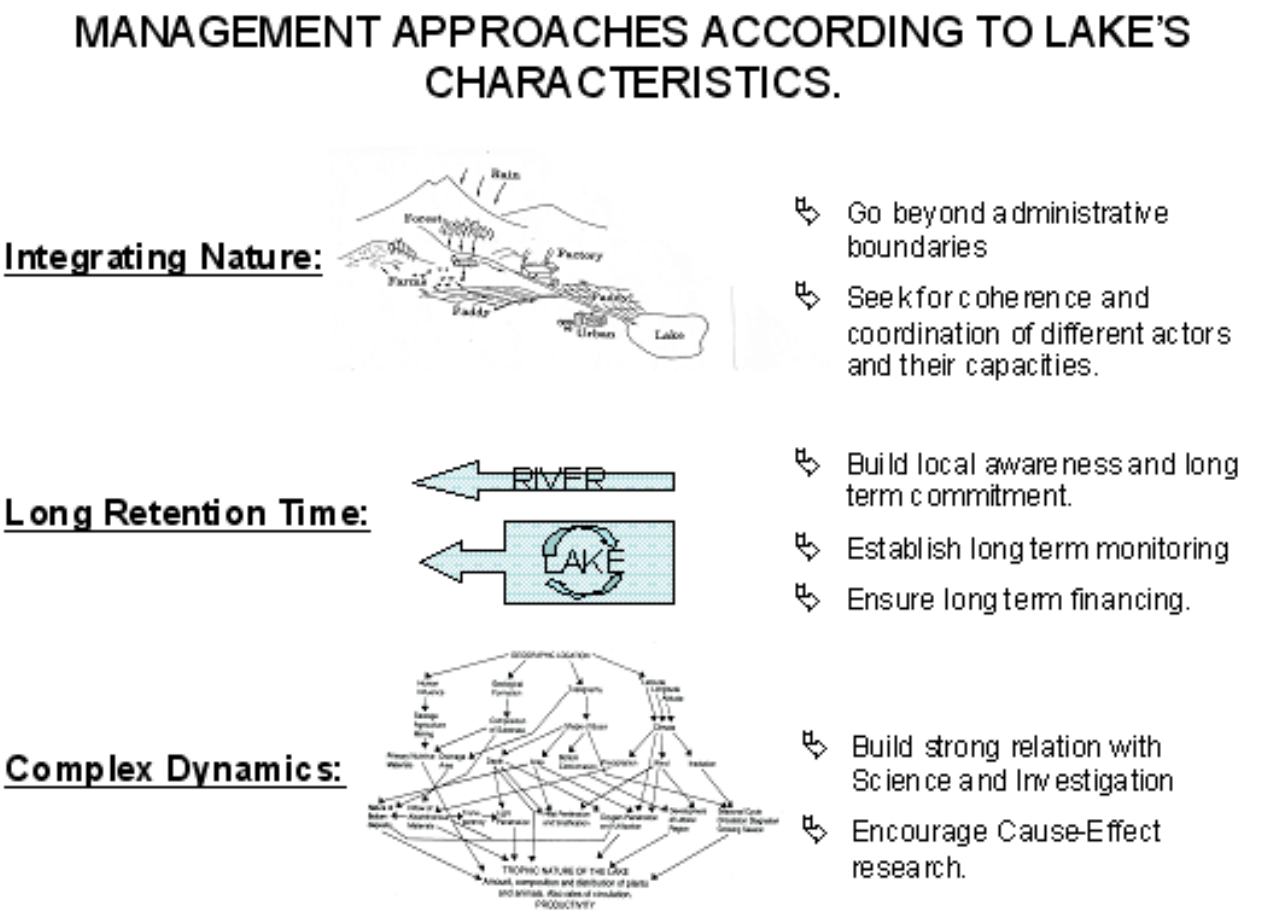
All this coordinating effort will also result in a more robust and credible database that will contribute to a more realistic decision making process when: 1. controlling the standard's compliance and 2. proposing (or not) the declaration of a Latent or Contaminated Area (Fig. 1).

Nowadays, almost anyone can take water samples and join the debate about water quality. Because of that, ensuring the status and credibility of "your data" is extremely important, in the first place to support adequate decision making processes and next to earn and maintain people's trust, authority's trust, politician's trust, local government's trust, etc.

Consistency, credibility and reliable decisions supports the need of good quality data, the lake's characteristics supports the need of a long term monitoring effort.

Lakes have all three common characteristics that should have a consistent application on their management: 1. Integrating nature, 2. Long retention time and 3. Complex dynamics (ILEC 2005).

Figure 4: Lakes' characteristics should have a representation in management approaches.
Limnological issues can provide strong management arguments.



These three attributes will finally mean that everything within the lake's drainage basin that can be carried by water, will end up inside the lake, will remain inside the lake for a long time and will interact with different lake components. The response, when managing a lake basin, should therefore have special considerations, such as go further than administrative boundaries and consider the watershed (or drainage basin), coordination for coherence among actors, long term commitment, long term financing, interaction with science, and so on (Fig. 4).

Lesson No. 3: Ensuring good quality data will ensure good quality decisions.

4. Making a water quality standard become more than that.

Lake Llanquihue's case is a very special one. According to local people, Lake Llanquihue has changed its quality over the last twenty years, being the most conspicuous symptoms the presence of bad odors (associated with sewage discharge), the presence of algae covering the bottom rocks and the shortage or absence of some native fish species (associated with salmon/trout releases). In spite of this information, that unfortunately cannot be contrasted with water quality data taken before the eighties, the actual available data is showing a lake with good transparency, good levels of oxygen and acceptable levels of nitrogen and phosphorus (Fig.5). There are no records of major phytoplankton blooms, intoxications, or any other problem associated with poor water quality.

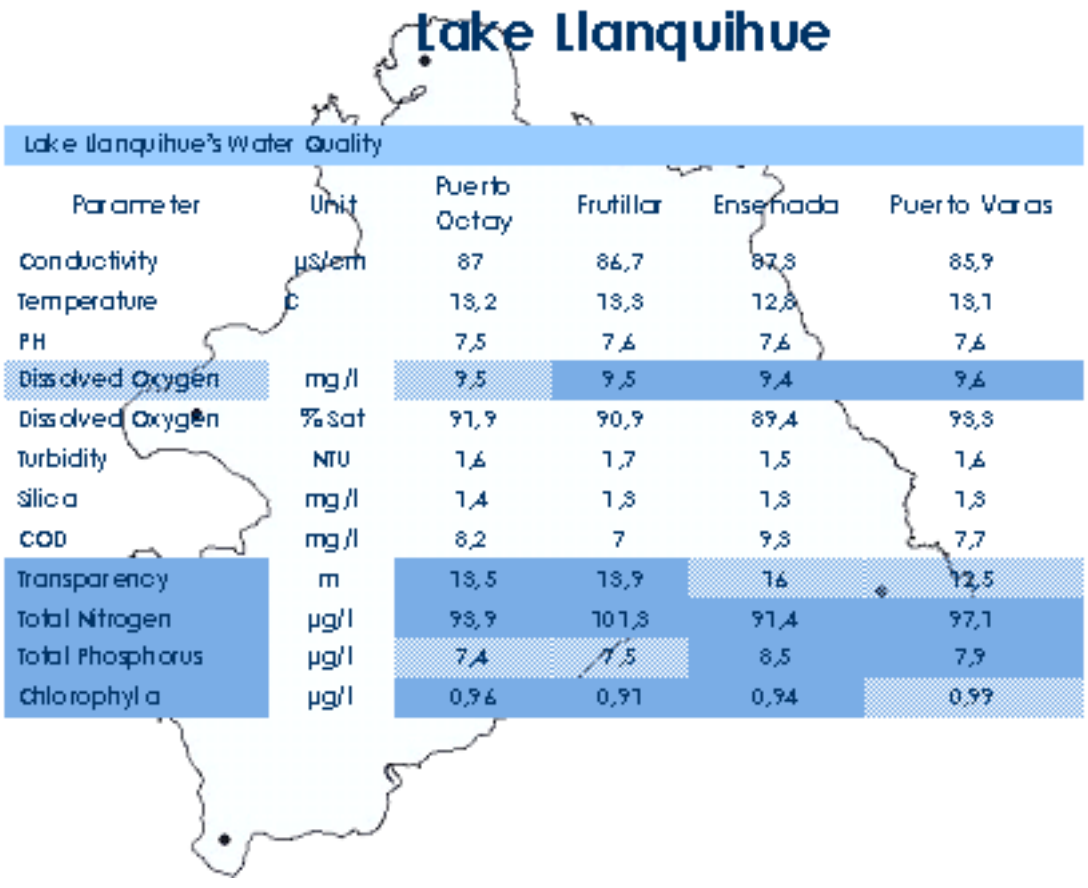
This condition is mainly due to the size of the lake, and its considerable water volume: 158.6 km^2 (see Fig. 6) and that its watershed is quite small if compared with the lake's surface (Campos *et al*., 1988). Another important condition is that only 0.43% of this watershed is occupied by cities, against a 18.4% occupied by evergreen forest (Fig. 6).

This scenario might seem quite favorable for environmental management, but paradoxically, the lack of major environmental problems associated to water quality makes a strong barrier to start working, mainly because "nobody cares".

To go beyond this inconvenience, it is important to establish the relevance of prevention as an "economic tool" if compared with recovery or abatement. Lakes are a great example to prove that prevention is less costly and more effective (and faster!) than remediation. This is mainly due to the long retention time. It is important to assume and understand that problems in a lake will remain for a long time and, solutions to these problems will take also long time and of course, resources to solve them (Fig 7).

For clean, oligotrophic lakes like Llanquihue itself, the establishment of a water quality standard, that the society

Figure 5: Lake Llanquihue's water quality data, showing an oligotrophic lake.



Lake Llanquihue's Water Quality

Parameter	Unit	Puerto Octay	Frutillar	Ensenada	Puerto Varas
Conductivity	µS/cm	87	86,7	87,3	85,9
Temperature	C	13,2	13,3	12,8	13,1
PH		7,5	7,6	7,6	7,6
Dissolved Oxygen	mg/l	9,5	9,5	9,4	9,6
Dissolved Oxygen	%Sat	91,9	90,9	89,4	93,3
Turbidity	NTU	1,6	1,7	1,5	1,6
Silica	mg/l	1,4	1,3	1,3	1,3
COD	mg/l	8,2	7	9,3	7,7
Transparency	m	13,5	13,9	16	12,5
Total Nitrogen	µg/l	98,9	101,3	91,4	97,1
Total Phosphorus	µg/l	7,4	7,5	8,5	7,9
Chlorophyl a	µg/l	0,96	0,91	0,94	0,99

is willing to maintain, can become the most effective preventive (and inexpensive) management tool. As shown in Figure 8, fixing the water quality standard in restrictive levels (low pollution or eutrophication) will help to detect early changes in water condition, and therefore implementing an earlier set of countermeasures to recover the standard quickly and with small effort.

For lake Llanquihue, as the Chilean regulation for establishing water quality standards considers citizen participation and forces further management if a quality standard is not accomplished, one of the most desirable scenarios is the establishment of a Latent Zone and the elaboration of a Prevention Plan, because this means that the standard is being accomplished and that there's already a management plan to prevent pollution and/or eutrophication. If Prevention Plans (even Decontamination Plans) are designed to reduce pollution and/or eutrophication in the entire watershed, automatically the establishment of a water quality standard will lead to Integrated Lake Basin Management (Fig. 8).

Lesson No. 4: Starting with a simple management tool such as a water quality standard can lead to the establishment of a more complex and integrated tool.

5. Building public awareness

It has been said previously that sometimes not having specific environmental problems can pose a problem too. In lake Llanquihue's case, during the process, it was said that

Figure 6: Lake Llanquihue's basin and its soil coverage percentages.
Most of the lake's watershed is occupied by prairies and forests.

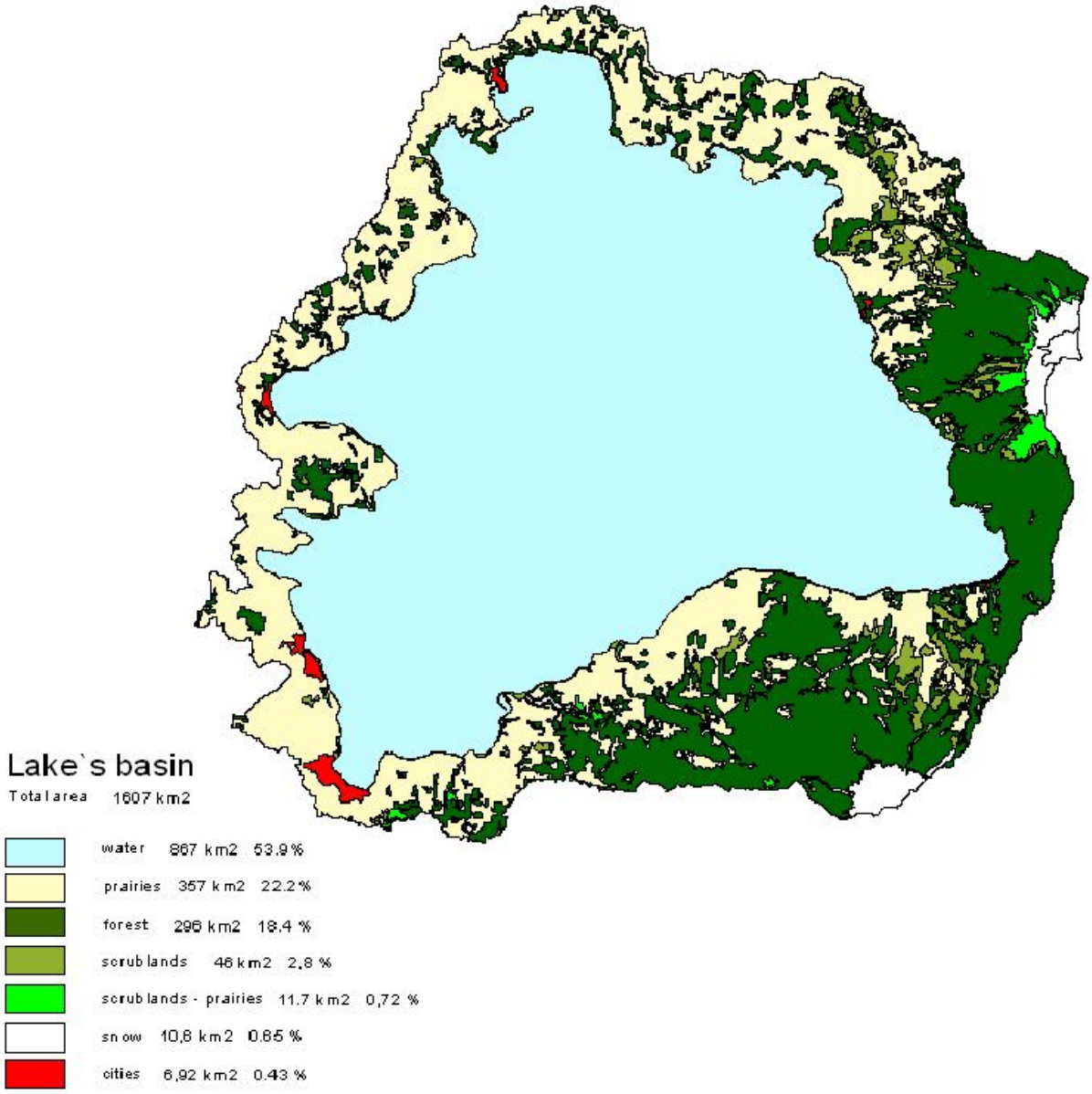


Figure 7: Changes in water quality in lakes are very slow and imperceptible when eutrophication begins.
This is because the input of pollutants or nutrients starts in low levels but increases steadily. In addition, due to the long retention times they accumulate inside the lake until an accelerated increase of concentration can be detected. The first frame is showing that a preventive approach can detect through monitoring very early changes in water quality. If monitoring is delayed until some symptoms appear, in the same time frame, a larger level of pollution will be reached. The second frame is showing that preventive approach (acting before having actual problems) can reduce pollution with more effectiveness in a shorter time frame.

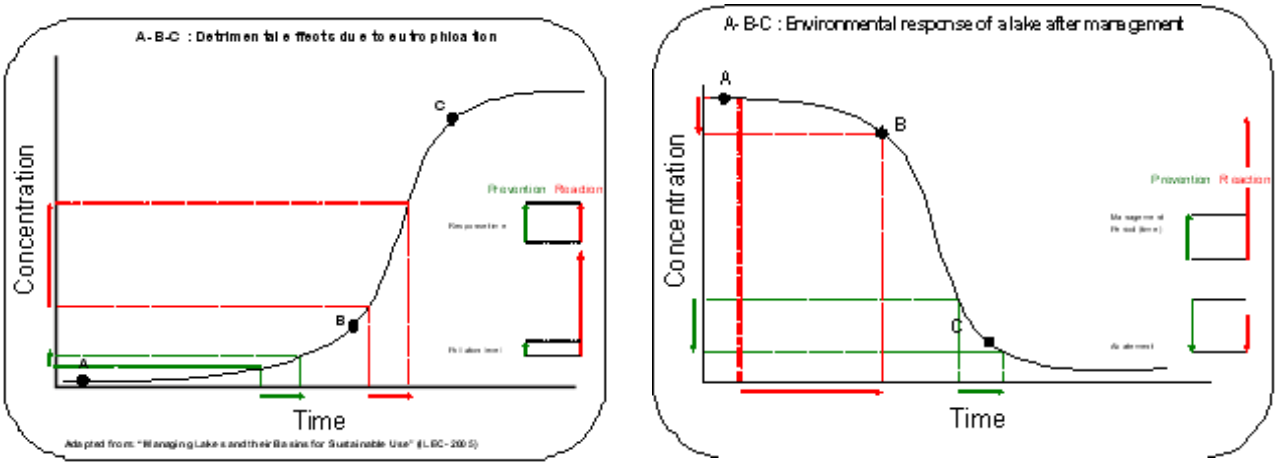
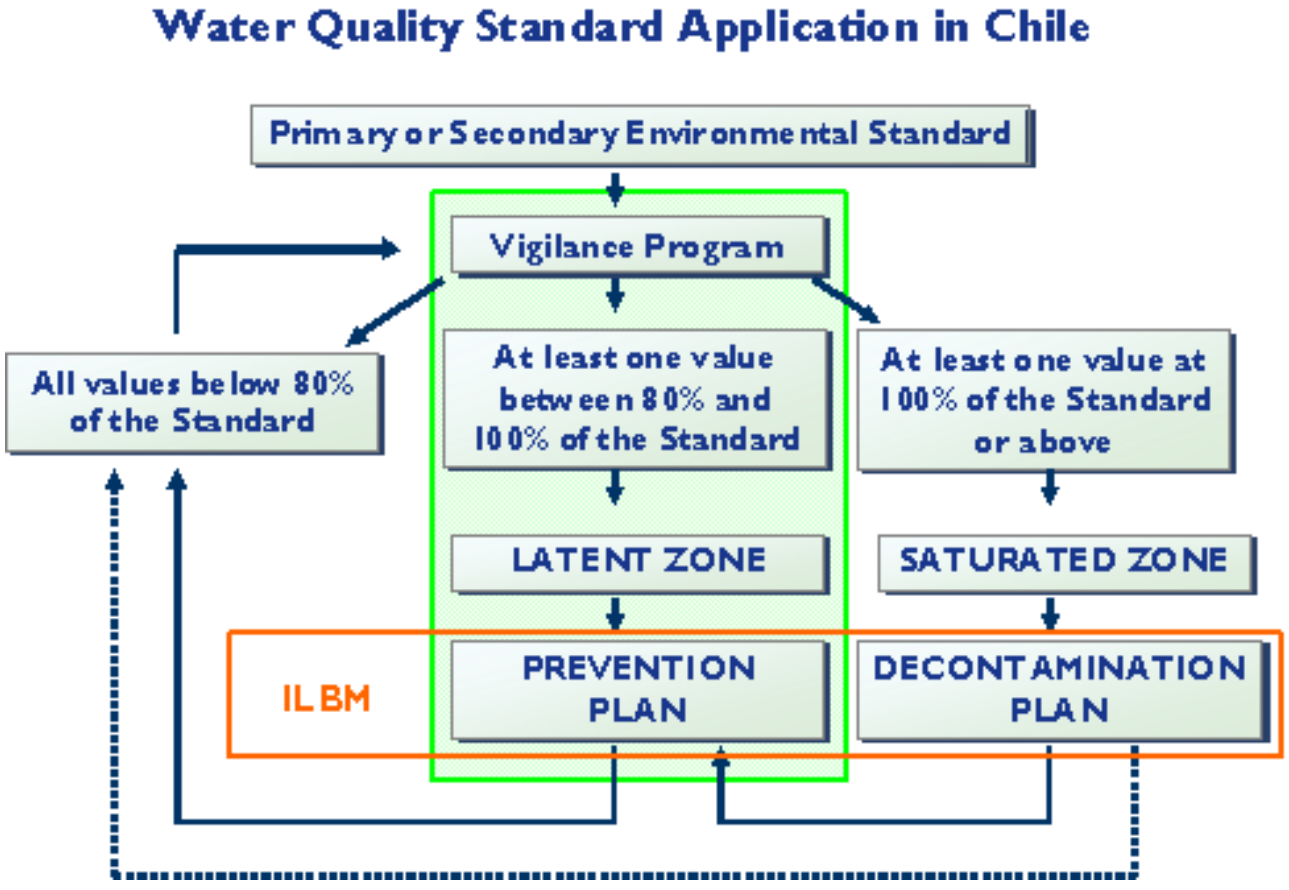


Figure 8: Diagram showing how a water quality standard is maintained, according to Chilean Regulation.
After the establishment of the standard, and the monitoring process, the Plans that could be implemented, can lead towards an integrated lake basin management program (ILBM).



the project did not have enough technical support. This last argument was not shared by the Operative Committee, and a second discussion started: Is it technical support what is missing, or is it political support or social support or even economical support that are missing?

After this discussion, some of the small funds available for working on the standard were oriented towards the community, and some effort was made to raise interest on the importance of lake conservation, the Committee's work and the results expected after the establishment of the standard.

As a result, many people participated during the citizen participation period and many observations pointed towards the need to establish a water quality standard, the need to improve monitoring activities and the fact that the lake is already damaged, at least in some enclosed bays.

If local people understand the need for action in terms of lake management and support all proposed actions it will be easier to convince major authorities to also support the initiatives, since that will be demanded by the community.

A well informed and compromised community will also facilitate the implementation of measures against pollution and/or eutrophication, since they will know the whole meaning of a plan and ideally will be included while planning.

Lesson No. 5: Interacting and working closely with the community can significantly help to improve and ensure management effectiveness.

6. Becoming a lake fan/expert!

Studying a lake in a developing country is quite difficult, mainly because of lack of funds for this kind of research. This condition might discourage learning and studying lakes. Nevertheless, investing some time learning from other lakes, making efforts to collect data from a specific lake, and look for training opportunities will help to raise strong arguments to keep on going on a lake's management.

One simple step is to collect and analyze data from a lake. Search for publications, for monitoring data and other information and process it to describe the lake is an excellent exercise to start and become "specialist" on that specific lake.

The coordination of a Committee on lake management in which some national experts can be included will also help to be familiarized with limnological terms and considerations and might conduce to the opportunity to design and carry out training courses.

The experience collected trough different countries can provide examples of management and results that can be reproduced into a specific lake, or at least can provide arguments to support environmental management into a given lake.

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