V-066 - STEPWISE IMPLEMENTATION OF WATER QUALITY STANDARDS IN DEVELOPING COUNTRIES

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ABSTRACT

The paper analyses the practical implementation of water quality standards, with a special focus on the following points of concern for developing countries: (a) Typical problems with setting up and implementing standards in developing countries, (b) the need for a stepwise implementation of the measures necessary to achieve the standards; (c) the principle of equity and (d) the need for institutional development.

KEY WORDS: Developing Countries, Wastewater Treatment, Water Quality Legislation, Environmental Standards.

INTRODUCTION

An adequate legislation for the protection of public health and the quality of water resources is an essential tool in the environmental development of all countries. The transfer of written codes from the paper into really practicable standards, which are used not merely for enforcement, but mainly as an integral part of the public health and environmental protection policy, has been a challenge for most countries. The paper analyses the practical implementation of standards, with a special focus on the following points of concern for developing countries:

- Typical problems with setting up and implementing standards in developing countries
- The need for a stepwise implementation of the measures necessary to achieve the standards
- The principle of equity
- The need for institutional development

In the text, the concepts of guidelines and standards are used. Guidelines are proposed by entities of overall acceptance (such as WHO), are generic by nature and usually aim at protecting public health and the environment on a worldwide basis. National standards are defined by each country, have legal status and are based on the specific conditions of the country itself. Depending on the political structure of the country, regional standards may also be developed, for each state, county or other political subdivision.

TYPICAL PROBLEMS WITH SETTING UP AND IMPLEMENTING STANDARDS IN DEVELOPING COUNTRIES

The inadequacies and difficulties in the setting up of discharge standards for developing countries have been already discussed by several researchers. Johnstone and Horan (1994, 1996) presented very interesting papers, analysing institutional aspects of standards and river quality and comparing different scenarios for the UK and other developed and developing countries. Von Sperling and Nascimento have analysed in detail the Brazilian legislation (von Sperling, 1998), covering aspects such as comparisons between the limit concentrations in the standards with quality criteria for different water uses (Nascimento and von Sperling, 1998), sensitivity of laboratory techniques (Nascimento and von Sperling, 1999) and requirements for
dilution ratios (river flow / effluent flow) in order to match compliance of water and discharge standards (von Sperling, 2000).

Table 1 presents a list of common problems associated with setting up and implementing standards, especially in developing countries. Some of the points have been discussed in the above mentioned references.

Table 1. Common problems associated with setting up and implementing standards, especially in developing countries.

<table>
<thead>
<tr>
<th>Problem</th>
<th>How it should be</th>
<th>How it frequently is</th>
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<tr>
<td>Guidelines are directly taken as national standards</td>
<td>Guidelines are general worldwide values. Each country should adapt the guidelines, based on local conditions, and derive the corresponding national standards.</td>
<td>In many cases the adaptation is not done in developing countries, and the worldwide guidelines are directly taken as national standards, without recognising the country’s singularities.</td>
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<td>Guideline values are treated as absolute values, and not as target values</td>
<td>Guideline values should be treated as target values, to be attained on a short, medium or local term, depending on the country’s technological, institutional or financial conditions.</td>
<td>Guideline values are treated as absolute rigid values, leading to simple “pass” or “fail” interpretations, without recognising the current difficulty of many countries to comply with them.</td>
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<td>Protection measures that do not lead to immediate compliance with the standards do not obtain licensing or financing</td>
<td>Environmental agencies should license and banks should fund control measures (e.g. wastewater treatment plants) which allow for a stepwise improvement of water quality, even though standards are not immediately achieved.</td>
<td>The environmental agencies or financial institutions do not support control measures which, based on their design, do not prove to lead to compliance with the standards. Without licensing or financing, intermediate measures are not implemented. The ideal solution, even though approved, is also not implemented, because of lack of funds. As a result, no control measures are implemented.</td>
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<td>Standards are frequently copied from developed countries</td>
<td>National standards should be based on the country’s specific economical, institutional, technological and climatic conditions.</td>
<td>National standards are frequently directly copied from developed countries’ standards, either because of lack of confidence on their own capacity, desirability to achieve developed countries’ status, lack of knowledge or poor knowledge transfer from international consulting companies. Cost implications are not taken into account. The standards become purely theoretical and are not implemented or enforced.</td>
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<td>Developed countries sometimes attempt to reach developed countries’ status too quickly</td>
<td>If the guidelines and even the standards are treated as target values, time would be necessary to lead to compliance. Each country, based on the economic and technological capacity, should take the time which is reasonably necessary to achieve compliance. Developing countries are naturally likely to take more time than developed countries. Developing countries should understand that current standards in developed countries result from a long period of investment in infrastructure, during which standards progressively improved.</td>
<td>The desire to achieve developed countries’ status too quickly can lead to the use of inappropriate technology, thus creating unsustainable systems.</td>
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<td>Some standards are excessively stringent or excessively relaxed.</td>
<td>Standards should reflect water quality criteria and objectives, based on the intended water uses.</td>
<td>In most cases, standards are excessively stringent, more than would be necessary to guarantee the safe use of water. In this case, they are frequently not achieved. Designers may also want to use additional safety factors in the design, thus increasing the costs. In other cases, standards are too relaxed, and do not guarantee the safe intended uses of the water.</td>
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<td>There is no affordable technology to lead to compliance of standards</td>
<td>Control technologies should be within the countries financial conditions. The use of appropriate technology should be always pursued.</td>
<td>Existing technologies are in many cases too expensive for developing countries. Either because the technology is inappropriate, or because there is no political will or the countries’ priorities are different, control measures are not be implemented.</td>
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<td>Compliance with standards are at a lower level of priority compared to other basic environmental sanitation needs</td>
<td>Each country, based on the knowledge of its basic conditions and needs, should set priorities to be achieved. If standards are well set up, they will naturally be integrated with the environmental control measures.</td>
<td>Basic water supply and sanitation needs are so acute in some countries, that standards are seen as an unnecessary sophistication.</td>
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<td>Standards are not actually enforced</td>
<td>Standards should be enforceable and actually enforced. Standard values should be achievable and allow for enforcement, based on existing and affordable control measures. Environmental agencies should be institutionally well developed in order to enforce standards.</td>
<td>Standards are not enforced, leading to a discredit in their usefulness and application, and creating the culture that standards are to remain on paper only.</td>
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<td>Discharge standards are not compatible with water quality standards</td>
<td>In terms of pollution control, the true objective is the preservation of the quality of the water bodies. Discharge standards exist only by practical (and justifiable) reasons. However, discharge standards should be compatible with water quality standards, assuming a certain dilution or assimilation capacity of the water bodies.</td>
<td>Even if water quality standards are well set up, based on water quality objectives, discharge standards may not be compatible with them. Some parameters in the discharge standards may be too stringent and others too relaxed. In this case, different assimilation capacities of the water bodies are implicit. The aim of protecting the water bodies is thus not guaranteed.</td>
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<td>Number of parameters are frequently inadequate (too many or too few)</td>
<td>The list of parameters covered by the national standards should reflect the desired protection of the intended water uses, without excesses or limitations.</td>
<td>In some countries, the standards include an excessively large list of parameters, many of which have no actual regional importance, are very costly to monitor or are not supported by satisfactory laboratory capabilities. In other situations, standards cover only a limited list of parameters, which are not sufficient to safeguard the intended water uses.</td>
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<td>Monitoring requirements are undefined or inadequate</td>
<td>Monitoring requirements and frequency of sampling should be defined, in order to allow proper statistical interpretation of results. The cost implications for monitoring need to be taken into account in the overall regulatory framework.</td>
<td>In many cases, monitoring requirements are not specified, leading to difficulty in the interpretation of the results. In other cases, monitoring requirements are excessive and thus unnecessarily costly. Still in other cases, monitoring requirements are very relaxed, not allowing interpretation of results with confidence.</td>
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<td>Required percentage of compliance is not defined</td>
<td>It should be clear how to interpret the monitoring results and the related compliance with the standards (e.g., mean values, maximum values, absolute values, percentiles or other criteria).</td>
<td>The non specification of how to treat the monitoring results may lead to different interpretations, which may result in diverging positions as to whether compliance has been achieved or not.</td>
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<td>Low standard values are sometimes below laboratory detection limits</td>
<td>If standards are treated as target values and are well linked with the water quality objectives, they should not be limited by current laboratory detection limits. In due time, laboratory techniques will improve and be consistent with the standard values.</td>
<td>Standards which are below the detection limit are sometimes seen as unjustifiable, which may be true in some cases, but not in many other cases.</td>
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<td>There is no institutional development which could support and regulate the implementation of standards</td>
<td>The efficient implementation of standards requires an adequate infrastructure and institutional capacity to license, guide and control polluting activities and enforce standards.</td>
<td>In many countries the health and environmental agencies are not adequately structured or sufficiently equipped, leading to a poor control of the various activities associated with the implementation of standards.</td>
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<td>Reduction of health or environmental risks due to compliance with the standards is not immediately perceived by decision-makers or the population.</td>
<td>Decision-makers and the population at large should be well informed about the benefits and costs associated with the maintenance of good water quality, as specified by the standards.</td>
<td>Decision-makers are frequently more sensitive to costs than to benefits resulting from the implementation of control measures. The population is not well informed, and does not drive politicians and decision-makers in order to invest in health and environmental protection.</td>
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<td>Excessive expenditure on unjustifiably high standards may lead to population disagreement with really worthwhile standards</td>
<td>Standards should really reflect the water quality objectives, and these objectives should result from a consensus from the various segments of the society, directly involved in the catchment area.</td>
<td>Representatives of the society frequently do not participate in the decision-making process. High costs, which are not seen as bringing correspondingly high benefits, may lead to discredit and disagreement when aiming at implementing standards which are really important for the involved community.</td>
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**STEPWISE IMPLEMENTATION OF STANDARDS**

Usually the stepwise implementation of a water supply or sewerage system is through the physical expansion of the size or number of units. A plant can have, for instance, two tanks built in the first stage, and another tank built in the second stage, after it has been verified that the influent load has increased, frequently due to the population growth. This stepwise implementation is essential, in order to allow reduction in present value construction costs.

However, another concept of stepwise implementation, which should be put in practice, especially in developing countries, is the gradual improvement of the water or wastewater quality. It should be possible, in a large number of situations, to implement in the first stage a less efficient process, or a process that removes fewer pollutants, transferring to a second stage the improvement towards a system more efficient or more wide-reaching in terms of pollutants. If the planning is well structured, the environmental agency could make allowances in the sense of permitting a temporary small violation in the standards in the first stage. Naturally a great deal of care must be exercised in not allowing that a temporary situation becomes permanent, which is a very common occurrence in developing countries. This alternative of stepwise development of water or wastewater quality is undoubtedly much more desirable than a large violation of the standards, whose solution is often unpredictable over time.
Figure 1 presents a typical situation concerning the implementation of wastewater treatment. If a country decides to implement treatment plants that can potentially lead to an immediate compliance with the standards, this will require a large and concentrated effort, since the current water quality is probably very poor, especially in developing countries. This large effort is naturally associated with a large cost. In most instances, the country cannot afford this large cost, and the plant construction is postponed and eventually never put into effect. On the other hand, if the country decides to implement only a partial treatment, financial resources may be available. A certain improvement in the water quality is obtained and health and environmental risks are reduced, even though the standards have not been satisfied. In this case, the standards are treated as target values, to be achieved whenever possible. The environmental agency is a partner in the solution of the problem, and establishes a programme of future improvements. After some time, there are additional funds for expanding the efficiency of the treatment plant, and the standards are finally satisfied. In this case, compliance with the standards is likely to be obtained before the alternative without stepwise implementation.

![Fig. 1. Concept of the stepwise improvement of water quality.](image)

Not only water and wastewater systems should expand on a stepwise basis on developing countries, but also the national standards for water quality. The following situations can occur:

- If the legislation in a developing country explicitly states that the standards are to be considered a target, than the national standards could have the same values as in the guidelines.
- If the concept of targets is not clear in the legislation, then also the numeric values of the limit concentrations could progress stepwisely towards stringiness. The standards should be adapted periodically, eventually reaching the same values as those in the guidelines.
- In any of the above cases, if there are specific conditions in the country, such as higher acquired immunity to some diseases, then the related standards not necessarily should need to converge to the guideline values.

The advantages of a stepwise implementation of standards and sanitary infrastructure are discussed in Table 2.

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<tr>
<th>Advantage</th>
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<td>Polluters are more likely to afford gradual investment for control measures</td>
<td>Polluters and/or water authorities will find it much more feasible to divide investments in different steps, than to make a large and in many cases unaffordable investment</td>
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<td>The present value of construction costs is reduced</td>
<td>The division of construction costs into different stages leads to a lower present value than a single, large, initial cost. This aspect is more relevant in countries in which, due to inflation problems, interest rates are high.</td>
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The cost-benefit of the first stage is likely to be more favourable than in the subsequent stages. In the first stage, when environmental conditions are poor, usually a large benefit is achieved with a comparatively low cost. This means that already in the first stage a significant benefit is likely to be achieved, with only a fraction of the overall costs. In the subsequent stages, the increase of the benefit is not so substantial, but the associated costs are high. The cost-benefit is then less favourable.

There is more time and better conditions to know the water or wastewater characteristics. The operation of the system will involve monitoring, which, on its course, will allow a good knowledge of the water or wastewater characteristics. The design of the second or subsequent stages will be based on the actual characteristics, and not on generic values taken from the literature.

There is the opportunity to optimise operation, without necessarily making physical expansion. The experience in the operation of the system will lead to a good knowledge of its behaviour. This will allow, in some cases, the optimisation of the process (improvement of efficiency or capacity), without necessarily requiring the physical expansion of the system. The first stage will be analogous to a pilot plant.

There is time and opportunity to implement, in the second stage, new techniques or better developed processes. The availability of new or more efficient processes for water and wastewater treatment is always increasing with time. Process development is continuous and fast. The second or subsequent steps can make use of better and/or cheaper technologies, than it would be possible with a single step.

The country has more time to develop its own standards. As time passes, the experience in operating the system and evaluating its positive and negative implications in terms of water quality, health status and environmental conditions will lead to the establishment of standards which are really appropriate for the local conditions.

The country has more time and better conditions to develop a suitable regulatory framework and institutional capacity. Experience obtained in the operation of the system and in setting up the required infrastructure and institutional capacity for regulation and enforcement will also improve progressively, as the system expands on the second and subsequent stages.

An important issue in the stepwise approach is how to guarantee that the second and subsequent stages of improvement will be implemented, and not be interrupted in the first stage. Due to financial restrictions, there is always the risk that the subsequent stages will be indefinitely postponed, under the argument that the priority has now shifted to systems which have not yet implemented the first stage. Even though this might well be a justifiable argument, it cannot be converted into a commonly used excuse. The environmental agency must set up scenarios of intervention targets with the entity responsible for the sanitary system. The scenarios should include the minimum intervention, associated with the first stage, and subsequent prospective scenarios, including required measures, benefits, costs and timetable. The formalisation of the commitment also helps in ensuring the continuation of the water quality improvement.

THE PRINCIPLE OF EQUITY

The principle of equity means that all peoples, irrespective of race, culture, religion, geographic position or economic status are entitled to the same life expectancy and quality of life. Broadly speaking, the reasons for a lower quality of life are associated with environmental conditions, and if these improve, life quality is expected to rise accordingly. On this basis, there is no justification for accepting different environmental guideline values between developed and developing countries.

If guideline values (e.g. WHO guidelines) are treated as absolute values, than only developed countries are more likely to achieve them, and developing nations possibly will not be able to afford the required investments. However, if guideline values are treated as targets, than hopefully all countries will eventually be able to achieve them, some on a short, some on a medium and others only on a long term.
Figure 2 illustrates this point, for three different countries. For all of them, the guideline values are the same. The very developed country has been already compliant, and presents a better water quality than actually required. The developed country requires only a small effort and achieves compliance in a short term. The developing country requires a stepwise approach and achieves compliance only on a long term. However, in the end all countries will be compliant with the guidelines.

**INSTITUTIONAL DEVELOPMENT**

An efficient implementation of standards must go in parallel with the development of the institutional framework necessary for monitoring, controlling, regulating and enforcing the standards. This topic is well discussed by Johnstone and Horan (1996) and some of the points are summarised below.

Institutional development takes time and the models cannot be directly copied from developed countries. Even though lessons should be learned from other countries which have already passed the basic steps of institutional development, an adaptation is also required in order to accommodate the countries’ specific economic, cultural and social conditions. However, experience from other countries can help in structuring the organisations, especially when they are introduced for the first time. It must be recognised that institutional development is a continuous process building on the experience of prior organisations.

Another important point is the need to separate the duties and responsibilities of regulating quality with those of achieving standards. This is especially true when private sector operators have to comply with standards.

The main points to be emphasised for developing countries are (Johnstone and Horan, 1996):

- Consider the process of institutional development and technical improvements to be long term
- Build on past experiences
- Separate regulatory and operational duties and responsibilities
- Develop regulatory systems and procedures needed to enforce standards
- Ensure that sufficient legal powers are in force
- Recognise the costs of regulation and legal enforcement

Fig. 2. Variation of time scale to achieve guideline compliance, for a very developed country, a developed country and a developing country (in all cases, the guideline value is the same)
CONCLUSIONS

- Stepwise implementation of standards and of sanitary systems is an approach which should be adopted by developing countries.
- Under the principle of equity, there is no justification for accepting different environmental guideline values between developed and developing countries.
- Guideline values should be considered as targets to be achieved over time, and not as absolute values. Developing countries are likely to take more time to achieve the targets than developed countries.
- If the legislation in a developing country explicitly states that the standards are to be considered a target, than the national standards could be the same as the guidelines.
- If the concept of targets is not clear in the legislation, then also the numeric values of the limit concentrations could progress stepwisely towards stringiness. The standards should be adapted periodically, eventually reaching the same values as those in the guidelines.
- Institutional development is also an integral part in the implementation of standards and needs to be pursued by countries.

BIBLIOGRAPH REFERENCES