OBJECTIVES OF AND PROCEDURES FOR SETTING STANDARDS

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Summary

There are two main stages in the formulation of public policy decisions to protect health and welfare against environmental hazards. They are the scientific stage, in which the risk of the hazard is assessed, and the administrative stage in which quality standards are established after considering all relevant scientific, technical and socio-economic aspects.

International co-operation is needed in setting environmental standards, especially on regional and global problems, and there are substantial benefits and advantages to be derived from such co-operation. The major advantage is that it makes available expert reviews of information from many other countries at low cost to the decision-makers. The following international programs and organisations, from which such advantages can be derived, are typical: the United Nations Environmental Programme; the WHO Environmental Health Criteria Program; the WHO Regional Office for Europe; and the International Agency for Research on Cancer.

The above issues, as well as other related issues of environmental standards, have been discussed in this article with particular reference to air pollution which is typical.

1. The general framework

Environmental problems at all levels—local, regional and global—are now priority for many governments around the world, due mainly to the rapidly growing importance of the subject and mounting pressure of public opinion. In response, wide-ranging policies are being developed at all levels to arrest, or reverse if possible, the relentless trend of environmental degradation.

The scope of environmental policies at the national or international level includes both the reduction of pollution and the preservation of natural resources, as well as promotion of an improved quality of life. Control of environmental pollution, and setting of standards in particular, is a major element of the process, and it raises difficult problems for the authorities, because there are diverse views on the extent to which an authority should or could protect its citizens against environmental risks, and at what cost.

The following examples illustrate the difficulties often encountered in setting environmental standards. Consider the case of people living near a waste disposal site. They are more likely to suffer the consequences of a possible accident at the site than those living away from it, even though the latter derive equal benefits from the site in terms of waste disposal. Whereas those living near the site are likely to opt for higher standards for the site even if it means greater costs, because this would improve their quality of life, those living away from it are less likely to do so. Next, consider the situation of those living near a proposed petrochemical complex with significant adverse environmental impacts. Clearly, they would benefit from the jobs that the complex would create, and so their opposition to the building of the complex would be much less strong than that of people living away from the complex who derive no direct benefit from it. They are consequently likely to insist on higher standards for the complex or on its relocation elsewhere.

The above are typical examples underlining the importance of public participation in decision-making, especially on matters and issues of public concern. Different population groups may be affected by environmental pollution in different ways depending on factors like age, sex, geographical location, standard of living, etc. Also, people belonging to different social groups have different perceptions of the costs and benefits of environmental protection projects and initiatives. Thus, a major challenge for governments and/or responsible authorities in standard setting is how to communicate effectively with their citizens with the aim of setting standards that are environmentally sound, socio-politically acceptable and economically viable. In practice this often turns out to be a difficult task, almost always ending up in a compromise.

Although there are different pathways (air, water, food, etc.) for the uptake of pollutants by plants and animals, in each case there is usually a “critical pathway”, which accounts for most of the uptake, that must be identified for efficient and cost-effective pollution control. Failure to identify the critical pathway is often a major obstacle to the alleviation of adverse environmental health impacts. Another problem is that some of the pollutants are chemically very stable (e.g. DDT and some synthetic insecticides), and so they degrade very slowly leading to accumulation over time.

The purpose of environmental health standards is to control hazards caused by the release of polluting substances into the environment. The potential of a pollutant to induce harm is referred to as “hazard”, while toxicity is taken to be the capacity of a substance to cause health injury to a living organism. The assessment of a pollution hazard should strictly be a scientific process of evaluating probabilities of occurrence using best available information. When the characteristics of the distribution of a pollutant into the environment and its effects have been determined, a detailed assessment is needed to establish the socio-economic parameters of the standards to be set to control it. The socio-economic parameters of a society largely determine the types and intensity of environmental impacts it can live with and the measures that may be taken to control pollution. Each country has its own legal framework for making decisions on control measures to be taken and for determining whether they should be advisory or mandatory.

There are two main stages in the formulation of public policy decisions to protect health and welfare against environmental hazards:

The scientific stage

- Identification and characterization of the hazard.
- Risk evaluation to establish the extent of potential health effects.
- Hazard assessment to identify routes of exposure and to estimate the number of people exposed.

At the end of this stage the levels of pollutant concentrations that do not produce adverse effects are determined along with the safety margins to be used as goals or norms in the various national environmental control programs.

The administrative stage

- Determination of acceptable risk. At this stage the approach to the problem is not strictly scientific.
- Determination of the population groups to be protected, by considering population groups whose particular physiological or health characteristics must be taken into account as a priority in comparison to healthy individuals.
- Consideration of human ecology. This involves an examination of the interaction between humans and the environment.
- Selection of control technology to be used.
- Legislation and standards. This involves consideration of the existing national legal framework and identification of necessary legal strategies.
- Economic considerations with particular reference to the costs and benefits of control measures to be implemented.

During this stage, knowledge of the technical, social, financial, legal and institutional implications of the solutions to be adopted is required. This knowledge facilitates an examination of the links between environmental problems with their solutions and with society at large. Attention is also given to the means with which to achieve the stated environmental health goals.

The general framework outlined above constitutes a logical and science-driven procedure for decision-making that may not always be followed in reality. In practice, decision-makers often have to find solutions in the existing environmental policies and measures, and in their strengths and weaknesses. Thus the decision-making process may be said to work in reverse, from the political to the scientific stage. This approach is subject to criticism, however, mainly due to the insufficiency of the data on which assessment is based. For example, uncertainties concerning the effects of chronic exposure to environmental pollution make it almost impossible to quantify the associated risks.

Considering these uncertainties, some suggest that it might be better to take all the necessary steps to eliminate avoidable risks irrespective of their precise quantification. However, the prevailing approach to pollution control is based on the principle that, given the scarcity of resources, maximum efforts should be made so that the imposed control is very closely related to the hazards of exposure.

An important additional consideration in standard setting is that laboratory tests should be carried out to determine the toxicological impacts of pollutants on animals like mice, dogs and pigs. However, because it is very costly to generate and collect such biomedical data, toxicological test protocols must be scaled up using bio-statistical methods to large human populations. These protocols are not yet very sophisticated, and so some major assumptions, based on limited scientific data, must be made in their extrapolation to humans. It is to be borne in mind while developing standards that, if the standards are set too high, major human health implications may not be detected. On the other hand, if the standards in one country are much lower than in another, then the country with lower standards would gain competitive advantage for their goods and services over that with higher standards. Also, it goes without saying that setting standards, however stringent, is of little use without an effective enforcement regime.

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Biographical Sketches

Dr. Pavlos Kalabokas obtained his first degree in Physics from the University of Athens, Greece, in 1983, followed by the Masters and Ph.D degrees in Air Pollution Chemistry from the University of Paris VII, France, during 1983-87. The topic of his research was "sampling and analysis of carbonyl compounds in the atmosphere of Paris, France".

He was a visiting scientist to the German Research Center KFA-Julich, Institute of Chemistry of Polluted Atmospheres, during 1987-1988, and to the German Research Center KFA-Julich, Institute of Applied Physical Chemistry, during 1989-1990. During 1991-1993 he was Research Associate at the Laboratory of Meteorology of the University of Athens working on the vertical measurements of tropospheric and stratospheric ozone over Athens. During 1994-1997 he was Research Associate at the Environmental Research Laboratory of the Greek National Center of Scientific Research "Demokritos" working on the analysis of air pollution data in Athens using atmospheric models.

Since 1997 Dr. Kalabokas has been an elected Researcher at the Research Center for Atmospheric Physics and Climatology, Academy of Athens, studying urban air pollution in Athens; rural ozone levels around Athens; atmospheric pollution around refineries; and air quality in the area of the proposed new airport of Athens (the NTU Athens project).

To date Dr. Kalabokas has published over 65 papers on the above research topics. His other scientific activities include review of papers for international scientific journals on environmental pollution, and review of research projects in the European Union. He is a member of the Greek Committee on Environmental Pollution problems.

Dr. Michael Christolis is a Civil Engineer specializing in environmental science and technology. Currently he is working as a research collaborator at the National Technical University of Athens (NTUA), Greece, on the mathematical modeling of environmental problems. He has so far accumulated twenty years of experience in air quality monitoring, pollutant dispersion modeling, assessment of the impacts of industrial accidents, design of emergency systems, and implementation of the Seveso Directive in Greece.

During 1983-1988 he was the Head of the Laboratory for the Air Quality Monitoring Network for the City of Athens. In 1988 he joined the Computational Fluid Dynamics Unit (CFDU) of the Chemical Engineering Department of the NTUA, working on research projects on the computational modeling of various applications focusing on environmental issues and problems.

Professor Nicholas C. Markatos obtained his Diploma in Chemical Engineering from the National Technical University of Athens, Greece, in 1967, followed by M.Sc, DIC and Ph.D degrees from the Imperial College of Science, Technology & Medicine, University of London, UK, during 1970 to 1974.

In 1983 Professor Markatos was appointed Director of the Centre for Mathematical Modeling and Process Analysis at the school of Mathematics and Scientific Computing of the University of Greenwich, London, England. At that time he was also a visiting lecturer to the Computational Fluid Dynamics Unit of Imperial College as well as working for CHAM Ltd, (Concentration Heat and Momentum, Limited), London, England. At CHAM he worked first as leader of the Aerospace Group (1976) and then, from 1977 until 1984, as Manager of the Applications Team working on various Fluid Mechanical, Thermodynamic and Transport problems.

Since 1974 he has served as technical consultant to many Research Centres, state institutions and industries.

In June 1980 he was awarded the "Certificate of Recognition" by the Inventions Council of NASA.

In 1985 Professor Markatos was elected Professor of Chemical Engineering at the National Technical University of Athens, and in 1990 he was elected Head of the Chemical Engineering Department. In 1991 he was elected Rector of that University.

Professor Markatos' main scientific interest is in the mathematical modeling of Transport Phenomena, Fluid Mechanics, Thermodynamics and Physical Processes like Fluid Flow (Laminar and especially Turbulent), Heat and Mass Transfer, Environmental Flows, Combustion, etc.

He is referee of scientific papers, reviewer of new books, as well as member of the Editorial Board of several international Scientific Journals.

He has published over 100 original scientific papers in international journals and participated and organized many international conferences, seminars and meetings all over the world. Author of two books, he has also published many articles in the popular press on Engineering Higher Education.