
STUDY

Translated by Tim Ennis

**REFLECTION ON
ENVIRONMENTAL POLLUTION***

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Environmental pollution levels in Santiago, especially air pollution, are a matter of concern both for the population at large and for the authorities. However, the author of this paper argues that discussion of possible solutions is usually presented in a highly emotional way, and the concepts employed are often erroneous, or else the discussants give them different meanings.

As well as suggesting concepts to enable the issue to be addressed from a common perspective, the author seeks to make the precepts contained in the political Constitution compatible with definitions of a technical and scientific nature. Based on this, general guidelines are proposed for dealing with problems of environmental pollution.

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Estudios Públicos, 40 (primavera 1990). "Reflexiones sobre contaminación ambiental".

Introduction

The concern in society for environmental quality is a reality that is gaining importance every day¹. One of the effects people perceive most strongly is environmental pollution and within this category, contamination of the air².

This concern has a series of very interesting characteristics to analyze for the purpose of understanding the forces driving it, as well as seeking ways to solve the problems detected.

Usually, in analyses or diagnoses of environmental situations, different spatial-temporal frameworks are confused, while aspects that are "spectacular" from the viewpoint of human perception tend to be magnified, even if they are not technically difficult to solve³, or else are of no danger to man or any other species, assets or ecosystem thought necessary to protect.

This paper will try—very succinctly, given the scope of the topic—to systematize the analysis of environmental pollution. Starting from a brief presentation of the development of concern and actions on environmental pollution in Chile, certain definitions and minimal initial technical arguments are examined. The paper then attempts to make these definitions compatible with the constitutional framework existing in our country, and concludes with a basic policy guidelines proposal for dealing with problems in a technical, political and socially coherent way. I want to state that the constitutional focus presented here corresponds to a layman's view on this issue, so it should only be seen as an exercise that attempts to reconcile technical concepts with the spirit of the legislation.

One of the most important premises underlying this paper is that the quality of life in society is composed of environmental, cultural, economic and social factors, among others, so it should be society that, in an informed way, decides the importance or weight to be assigned to each factor as it sees appropriate. For this reason it is vital that the benefits and costs, both direct and indirect, at a local, regional and national level, be known, along

¹ This paper, however, will only focus on an analysis of the environmental pollution.

² The reason for this perception is twofold. On the one hand there is the visibility of atmospheric emissions, as well as the loss of visibility that these produce; and on the other hand, the fact that air pollution affects a resource whose consumption is not controlled. We all need to breathe, and in doing so we can not discriminate between clean and dirty air.

³ In this regard it is very interesting to read the paper by Juan Gastó, Eduardo Schmidt and Mario Trivelli, "Medio Ambiente: ¿moda o realidad?", *Centro de Estudios Públicos Working Paper* (October 1990), in which they differentiate environmental problems as such from those, for example, which constitute problems of "engineering".

with any responsibilities and constraints, at the individual and social group levels, that this decision implies.

This information requirement is of the utmost relevance, given that the origins, effects, and evolution of environmental pollution problems are complex, and generally involve combination of natural and social processes whose outcome is the emergence of uncompensated social costs.

For the purpose of the analysis, evaluation and eventual solution of environmental pollution situations, it is important to bear in mind that the perception and social valuation of human activities affecting the environment is dynamic, so their evaluation should consider the spatial, temporal and cultural context, as appropriate. Indeed, activities that at the present time are seen as polluting agents that negatively affect environmental quality, and hence quality of life, in the past were considered positive activities.

This situation does not mean that society should respect rights of ownership or vested interests, or be willing to compensate owners of such rights for the restrictions they wish to impose on them. However, the dynamic nature of the perception and evaluation of environmental situations and problems, makes it advisable at least to generate a process of negotiation with the activities involved, in order to establish time periods to permit activities to adjust to the restriction being imposed, in a consensual and coordinated way. Having said that, these time periods should be consistent with the goals of solving environmental problems as demanded by society, as well as with other types decisions relating to the operational framework (regulations and rules) normally imposed on activities in our society (changes in the tax regime, variations in interest rates, etc.), and for which special time periods are generally not granted, apart from the time physically needed for implementing the changes.

Development of a Concern for Environmental Pollution in Chile

From an analysis of legislation and the administration of environmental pollution problems in our country, it can be inferred that there has been no clear policy for dealing with them, and hence no environmental institutional framework that has addressed the problems in an efficient manner. This has translated into the fact that most of the legal attributions were dispersed, located in different sectoral ministries, with no coordinating entities with sufficient attributions until the creation of the National Environmental Commission and the Special Commission for the Decontamination of the Metropolitan Region (in September and April 1990, respectively).

Historical environmental legislation in Chile has evolved as the outcome of specific approaches aimed at solving specific problems—sometimes restricted to a single spatial and temporal context—which has meant that at the present time there are a large number of *ad-hoc* rules, scattered in various pieces of legislation and controlled by different state agencies. In turn, these standards, which might have been appropriate for solving specific problems in the past, were legislated to be applied throughout the country, leading to regulations and rules that are inappropriate and inefficient.

Furthermore, from the conceptual and technical point of view, this body of rules is not consistent in terms of the approaches used. The only common aspect of the ruling legal framework on the environment is an excessive reliance on the capacity for control and inspection by the State, for which reason the current legislation gives a high degree of discretionary power to public-sector officials. On the other hand, the assignment of responsibility for control and inspection of environmental pollution is not matched by a budgetary allocation of the resources needed to adequately fulfill such a role, with the result that much of the legislation has become a dead letter.

The history of environmental legislation in Chile can be divided in two broad stages: before and after the 1980 Constitution. Prior to the promulgation of the Fundamental Charter and thus of the right to live in a pollution free environment, the pollution control was based on norms such as:

- The Sanitary Code, which gives rise to numerous specific rules regulating both pollution of the working and community environment—air, water and soil—as well as food products and, in general, any type of pollution, in order to protect human health.
- Laws, Decrees with Legal Force, Supreme Decrees, Resolutions and Specific Rules additional to the Sanitary Code regulating specific aspects of pollution. These include rules establishing standards of water quality required for different uses (Ministry of Public Works); rules on the emission of pollutants by mobile sources (Ministry of Transport); rules on the use of organochlorate pesticides (Ministry of Agriculture); building regulations (Ministry of Housing and Urban Development) and various municipal rules and regulations.

This means that control of pollution was based on the initiative of public-sector agents in promulgating legislation and subsequently enforcing it.

Since the passing of the 1980 Constitution, the bulk of activity relating to environmental pollution control has been based on the right to live in a pollution-free environment, via the presentation of injunctions by the community in the law courts. In other words, actions of environmental pollution control ceased to be in State hands and became subject to initiatives by the community (-ies) affected.

Legal actions based on injunctions that have become landmarks in the national environmental field include the following:

- Against industries manufacturing fish meal in Arica, due to the bad smells produced.
- Against the Ministry of Public Works, due to the possible environmental impact the drawing of water from the Chungará lake might cause.
- Against CODELCO (Chuquicamata Division) due to pollution by sulfur dioxide and arsenic.
- Against the Metropolitan Environmental Health Service, due to environmental problems generated by the Lo Errázuriz sanitary landfill in Santiago.
- Against the Salvador Division of CODELCO due to contamination by copper tailings in Chañaral bay.

Perspectives

Concern for the preservation of the environment is now a reality integrated into the feelings of our society. This is being reflected in a public demand for environmental quality which will mean a steady increase in the environmental standards to be imposed on infrastructure, transport and industry projects, among other things.

To comply with these standards, projects will have to draw up environmental impact studies prior to construction and, probably, prior to approval. This condition is already common in projects financed by multi-lateral agencies such as the World Bank and the IDB.

In the case of activities whose impacts mainly involve environmentally polluting emissions— either to air, water or soil— it is expected that increasing restrictions will be imposed, for which reason two possible paths are foreseen:

- (i) The imposition of emission standards by activity type, where it will be State that decides how to vary the standards as a function of how the number of emission sources evolves in the different branches of econo-

mic activity. The standards can even establish the type of control equipment or specific fuels emitting sources are obliged to use. This *dirigiste* approach has lost validity at the world level as, after being applied in many developed countries, it was shown that although under certain circumstances it can meet the desired targets, it does not do so in the most efficient way. In this approach it is State discretion that decides which activity puts greatest demand on environmental resources, independently of the decisions and willingness to pay of each emitting source.

(ii) The creation of a system of environmental quality control based on market mechanisms, which would allow agents operating in each economic activity to decide for themselves what type of control to implement. Under this approach, the role of the State is to define the environmental quality standards desired by society, implement a system to assign the environment's assimilation capacity between users, ensure that the standards are not exceeded and keep up constant scientific research and environmental education.

Systems of this type have been used for a long time in the control of water contamination and are beginning to be used in the control of atmospheric pollution. Unlike what is normally suggested, implementing controls to avoid environmental degradation is complementary, rather than antagonistic to a social market economic system. The basic difference from the previous approach is that the correction of negative externalities in a free economy assumes that private agents have better information than the State, both on productive processes and regarding society's preferences. The policy for pollution control in Santiago has chosen to use tradable emission permits as a tool for meeting environmental quality targets, which means an approach based on market signals will be used.

Constitutional Rights and Duties and Related Concepts

Without pretending in the least to make an analysis of everything contained in the Political Constitution on the State of Chile relating to environmental problems, and specifically environment pollution, we present below the articles of the Constitution which in the view of specialists relate most closely to the subject under discussion.

Article 19. The Constitution ensures all people:

Nº 8: The right to live in a pollution-free environment. It is the duty of the State to ensure that this right is not affected and to ensure the preservation of nature.

The law may establish specific restrictions on the exercise of certain rights or freedoms in order to protect the environment.

Nº 21: The right to carry on any economic activity which is not contrary to morals, public order or national security, always respecting the legal norms that regulate it.

Nº 23: The freedom to acquire ownership of any type of good, except those which nature has made common to all men, or which ought to belong to the nation as whole, and the law so declares. This, notwithstanding that prescribed in other clauses of this Constitution.

When national interest so demands, a law of qualified quorum can establish or set limits or requirements on the acquisition of ownership of certain goods.

Nº 24: Property rights in their diverse forms over all types of physical and non-physical goods.

Only the law can establish the means of acquiring ownership, as well as the use, benefit from and disposal of it, and the limitations and obligations which derive from its social function. This covers whatever the general interests of the nation, national security, utility and public health and the conservation of environmental assets may require.

Nobody, in any circumstances, can be deprived of their ownership of a good or any of its attributes or central faculties of ownership, except by virtue of general or special law authorizing expropriation due to public utility or national interest, as declared by the legislature. The expropriated agent may bring a lawsuit against the legality of the expropriatory act before the ordinary courts, and will always have the right to compensation for the reduction in wealth effectively caused, as fixed by common agreement, or in a legal ruling decreed by these courts.

...

The rights of private individuals over water, recognized or constituted in accordance with the law, will grant ownership to the holders of such rights.

It is clear that the articles detailed above comprise a framework which, on the side of either rights or of obligations, restricts actions both of individuals and the state in their regulatory and governing actions.

Moreover, from the duties and rights that the Constitution establishes regarding the environment, four fundamental precepts can be derived which can serve as a guide to the aims, policies, legislation and institutional framework of the Chilean State on environmental issues, in harmony with the Constitutional duties and rights stipulated on other matters.

These precepts are:

- a) Protecting the environment.
- b) Preserving environmental heritage.

- c) Maintaining a pollution-free environment.
- d) Conserving nature.

In order to analyze the implications of these constitutional precepts certain basic concepts need to be defined.

The definition of concepts and precepts derived from the Constitution may lead to the development of mechanisms for regulation and rules aimed at totally different objectives via different interpretations of the terms involved. For that reason it is advisable for this stage to be submitted to consultation and analytical discussion, in which support from the scientific community will be vital.

This paper will focus on an analysis of the best known constitutional provision, which is the right to live in a pollution-free environment and, thus, one free from atmospheric pollution, keeping clearly in mind that there are very strong relations between contamination, environmental preservation and conservation of nature. The first step consists therefore in defining the term "pollution".

Pollution: Presence in the environment, due to human activities⁴, of living or inert elements, energy or a combination thereof, in concentrations⁵ and durations greater than those specified in the ruling legislation.

In order to analyze this definition of pollution it is also necessary to define "emission", for pollution control requires acting on emissions (an aspect which often leads to thinking they are synonymous concepts).

Emission: Discharge into the environment of any kind of living or inert element, energy or combination thereof, with physical, chemical or biological properties different from those of the receptor medium.

The main relevance of these definitions is that they mean that contamination cannot be evaluated out of context, and that the mere existence of emission does not imply there is pollution.

From this point of view, below we analyze aspects that constitute the context in which, in our judgment, the Constitution should be understood, so as to conclude with some specific recommendations of points that should be included in environmental policy and legislation on environmental pollution.

⁴ This does not mean that there is no such thing as pollution of natural origin, or that people do not have the right to refuse to live in naturally contaminated environment caused by volcanic eruptions, mineral leaching, erosion by wind and other elements; only that the legislation which emanates from this Constitutional provision had to consider the difference between pollution produced by human beings, which is therefore "controllable", and that of natural origin which also can be managed but which in a large number of cases, especially in the short run, has to taken as given.

⁵ For certain highly toxic pollutants, concentrations can perfectly well be zero.

1. The contamination of the environment can be assessed in relation to specific protection goals (human health, flora, fauna, aesthetics, etc.). In turn, each of these protection goals implies elements, compounds, levels and durations (exposure) which are specific and different.

Moreover, the definition of different protection targets is intimately linked to goals for the quality of life, beliefs and culture, as well as other societal issues. Thus, for certain societies it may be more important to protect flora than fauna, whereas for other groups the most important thing might be the protection of historical monuments⁶, for example. This aspect assumes special relevance at the moment of defining environmental quality standards, which are what indicate the decisive level beyond for deciding whether or not there is pollution.

The definition of environmental quality standards implies carrying out research to establish cause-effect relationships for different elements or compounds, (or for a combination thereof, which is even more complicated) in the short, medium and long run. This research is difficult to carry out and requires a large amount of resources, a situation which leads to copying standards "produced" in other countries, normally developed ones. This is not necessarily negative, because otherwise we would be restricted to protecting ourselves only from pollutants for which we had carried out our own investigations. However, the copying of other countries' environmental quality standards should be accompanied by their adaptation to the quality of life targets underlying that standard.

An interesting case in this respect is the prohibition of the organochlorate pesticide DDT in the United States, where one of the justifications (obviously not the only one, and this example should not be understood as an attack on its prohibition in our country), was that due to the use of DDT, the eggs of the bald eagle (the national bird of the USA) were losing calcium and so their reproduction rate was declining with consequent risk of extinction. It should not be forgotten, however, that these pesticides were partly responsible for the huge increases in agricultural productivity in both developed and in developing countries, which has led to the reduction of malnutrition, mortality and, in general, a significant improvement in the quality of life.

As can be seen below, Figure N° 1 shows iso-damage curves for different exposures (in terms of concentration and duration). What these

⁶ Such are the specific cases of Athens and Mexico City, which share similar environmental pollution situations to Santiago, but which have certain additional protection goals due to the existence of archeological ruins, which may cause them to define environmental quality standards that are more demanding than if the only purpose was the protection of human health.

curves show is that the same damage is caused by a high concentration over a short period (T0, C0), as for a lesser concentration over longer periods (T1, C1).

The assumptions mentioned above suffer from shortcomings such as the small volume of experimental data, the absence of information on long-term effects and the variability of human beings, among others. One result of these shortcomings is that maximum permissible levels are set considering safety factors which may take them to account. This situation is plotted on the lower curve of Figure N° 1.

It should be pointed out that as the damage to a group increases, the curves shift upwards parallel to the vertical axis, to reach a level where the concentration-time combination causes death. The maximum permissible levels subsequently stipulated as environmental quality standards are set with regard to the most sensitive segments of population, as well as the safety factor mentioned above, for which reason in general the average human being is considerably protected when an environment complies with the quality levels expressed in a standard. What is impossible to evaluate with the information currently available, are the effects of concentration shocks.

Finally, it can be seen that a situation that is continuous is presented as discrete (air quality standards are in general expressed in time units of 1, 8 and 24 hours, as well as monthly and annual averages), which leads to disguising, via averages, realities such as extremely high concentration during short periods, which are the most harmful to health in terms of acute effects, as they can lead to cardiac and respiratory crisis, intoxication and other effects.

To illustrate this effect, below we present the daily averages of breathable particulate material for certain months in 1990 in the *Parque O'Higgins* and *Avenida La Paz* metro stations. The index 100 represents the environmental quality standard, or maximum permissible level, while the level 500 represents concentrations where additional deaths would be caused among the most susceptible people (Figure N° 2).

FIGURE N° 1: ISO-EFFECT CURVES FOR DIFFERENT CONCENTRATIONS AND EXPOSURE PERIODS

Concentration
Time of Exposure

FIGURE Nº 2: INDEX OF BREATHABLE PARTICULATE MATERIAL,
MAY-JUNE 1990

(Monitoring stations Parque O'Higgins and Avenida La Pa, in Santiago)

May, June, July

This situation has recurred over the last three years at least in our capital; before that, this pollutant was not measured so it is not possible to say what happened. However, from specific analyses carried out in 1983 and 1980 we can infer that at that time the situation in Santiago was already similar.

2. Pollution needs to be understood in relation to elements and compounds, both specific and otherwise, which in turn need to be evaluated by objective methodologies and clearly defined and replicable techniques (even in cases which might appear to be qualitative, like pollution by smell).

What we wish to make clear is that there are many kinds of pollution, and each one produces effects specifically related to the characteristics of the elements or compounds involved. In turn, the analytical measurement methodology used for their evaluation will have a big influence on the results obtained. As in our country there is insufficient technological capacity to satisfy the demand for emissions measurement generated by environmental regulations, unreliable and non-replicable results are frequently obtained.

The population tends to associate or to assimilate contamination to some visible effect, so air contamination comes to be synonymous with pollution by particulate material⁷, or due to photochemical smog, but not with odorless or colorless gases, which can be much more dangerous⁸ but less visible. Experiments carried out in the USA have shown that peoples give much greater importance to dealing with pollution that reduces visibi-

⁷ The most visible particulates are the smallest (approximately 1 micron in diameter), due to their capacity for interfering with light, as their diameter is similar to the wavelength of visible light.

⁸ In turn, human beings have developed an ability to smell certain highly toxic gases, such as sulphuric acid for example, which in some cases exceeds the lower detection limit of instruments.

lity, increases cloudiness or causes smells⁹, than plans to reduce types of pollution that cause increases in cancer rates.

3. Pollution should be evaluated in the receptor medium that accommodates the subject or object to be protected.

This statement, which seems so obvious, is one of the aspects which most leads to controversy, even among professionals dedicated to controlling pollution. The environment has a capacity for assimilating the emissions discharged into it. If we wish to take advantage of the renewable natural resource characteristics present in the atmosphere, water courses, lakes and soil, we need to be capable of permitting emissions into the environment, making sure these emissions do not exceed the medium's capacity for assimilating and neutralizing them. Nevertheless it should be recognized that there are some highly toxic pollution emissions, for which reason their emission should not be allowed to enter the atmosphere. These types of pollution defined as "with no dose-response threshold" should adhere to an environmental control procedure that guarantees their non-emission into the medium.

Despite the environment's characteristic of self-purification, we need to evaluate in the medium where the object for protection is located, not only the magnitude of concentration of a certain element, but also how it occurs. This situation is extremely important in irrigation water where, for example, it is not the total quantity of heavy metals present in the water that is important, but the state in which they are found, because if they are not soluble they will not be assimilated by vegetables. On the other hand, their accumulation in the soil may alter its Ph. characteristics, lowering its productivity for certain crops, while raising it for others.

Making use of the environment's capacity to absorb emissions is what is understood by the concept "environmental conservation". This concept involves using the environment in such way that it maintains its potential to improve the quality of life in society. Thus, the environment should be seen as a potential for development, as it offers possibilities through its possible transformation and use in the context of conservation.

Complementary to the concept of environmental conservation is that of "preservation", which involves the maintenance of conditions that make possible a natural evolution of species and ecosystems. In an appropriately

⁹ In this context it is worth mentioning that even in the case of odors there are quantitative methodologies which can evaluate them, either from the point of view of nuisance to the population (for which there are dilution tests in which a representative sample of the affected population has to smell different dilutions of the odoriferous gas in order to determine the sensibility threshold), or of specific concentrations of the compounds giving rise to a smell such as in the case of mercaptan.

managed system there should therefore be room for the two concepts to exist in harmony: "conservation", which involves using the environment for mainly productive goals involving direct intervention by man in adapting his surroundings, and "preservation" which by definition is a use in which men "act as if it were not natural" and, therefore is excluded from processes of species and ecosystem evolution.

4. Considering that under the terms of the Constitutional precept, pollution only becomes relevant when it is the result of human action, the available use capacity of the environment should consequently be defined as the difference between the initial (natural) environmental situation and the environmental situation stipulated by the standards in force.

This means that the emissions from a given source should not be assimilated to contamination of the receptor medium. To say that a source is polluting one has to measure the impact this specific source has on the environmental component in question.

Having said that, nothing prevents environmental quality standards being defined that are so high (environmental quality standards very close or equal to pristine environments) where at the limit, emission becomes synonymous with pollution.

Furthermore, the concept of emissions/pollution control should be integral, for otherwise it would be sufficient to transfer the emissions of a chimney to drains or soil, or vice-versa. Pollution control should be implemented with a clear environmental quality target, which is coordinated and integral, ensuring that the quality standards in other components of the environment are not exceeded. There are many examples of this, ranging from industries that capture their own emissions using wet scrubbers but which end up in drainage systems, or through filters where the material captured ends up in sanitary landfills, to the sad cases of numerous villages in Chile where the drainpipe "solution" was adopted to solve "sanitary problems". The "solution" consisted simply in transferring waste water which mostly could be correctly treated through septic tanks, in a concentrated way to some hidden place for disposal, thereby causing a new and more serious sanitary problem.

In the special case of air contamination in Santiago (the analogy of course can be extended to any situation), the impact on the recipient medium must therefore be evaluated in a dual context:

- I. The marginal contribution made by emissions from the given source to the total pollution of the city or area which it is desired to protect.
- II. The specific impact of emissions from that source on a local area.

From the conceptual and theoretical point of view the most unfavorable of these two situations (in the sense of the one that exceeds or implies surpassing environmental quality standards) should define the maximum emission possible from each respective source. Having said that, in order to define both the source's contribution to the total in the city, as well as its specific influence, one needs to be aware of natural conditions and the mix of existing activities, to serve as an initial frame of reference.

This duality of impacts produced by sources emitting atmospheric pollutants will be managed in two ways, given the different characteristics of each situation:

In the case of the marginal contribution, one has to consider the implementation of a system to enable the sum total of emissions coming from all existing activities in the area to be managed, not to exceed the maximum permissible limits of atmospheric pollution, under pre-defined pollutant dispersal conditions. In this context, we should not forget that this is an essentially random phenomenon, with respect to which one cannot be one hundred percent certain that given climatic conditions will be repeated.

In the case of impacts on specific areas, control should be effected by stipulating compulsory emission standards that guarantee compliance with air quality standards at the points of maximum impact.

As an example, this means that for a given atmospheric basin one has to define how much can be emitted under average or most unfavorable meteorological conditions, depending on the intention of the regulatory organization¹⁰, as a global annual level. This should be calculated as as the sum of total partial emissions allowed over shorter time periods (by way of example one might say that a source of particulate emissions could be authorized through the acquisition of tradable permits, to emit X tons of particulate per day between October and February, X/2 during March, April and September, and X/4 in the months of May, June, July and August, whereby its maximum annual emission is the product of the weighted sum of the partial emissions). On this basis the environmental quality standard should not be exceeded (in this case with the aim of protecting human health) for an exposure period of one year — $75\mu\text{g}/\text{m}^3$ as a geometric mean of daily concentrations or $50\mu\text{g}/\text{m}^3$ if we consider the breathable portion alone.

¹⁰ The choice of different scenarios for pollutant dispersal (an aspect valid both for air —wind-speed, for example— and for water currents) will have a direct effect on the frequency with which the norms or standards are exceeded. The more unfavorable the natural conditions assumed for pollutant dispersal, the lower should be the emissions level at which environmental quality standards define pollution.

In turn, the emission of X, X/2 or X/4 tons per day during the respective periods cannot mean that the environmental concentration standard is exceeded in terms of particulate material for an exposure of 24 hours —265 $\mu\text{g}/\text{m}^3$, or 150 $\mu\text{g}/\text{m}^3$ if only the breathable portion is counted.

5. As a final point related to defining the concepts relevant to environmental pollution, it needs to be said that although pollution has been defined as concentrations and durations greater than those “stipulated in current legislation”, the dynamic of the environmental problem itself will cause legislation to constantly evolve to regulate a greater number of elements and compounds, while making permissible limits for already regulated pollutants stricter, as their concentrations become associated with greater risks. Against this, there are some exceptional cases where greater knowledge of its effects has led to a rise in maximum permissible concentrations for the pollutant in question.

It is a fact that has been demonstrated both at the national and international level, that the environmental impact caused by non-regulated pollutants (it is impossible to pretend that standards exist for the large number of substances which due to the effect of different exposure situations may affect human beings or some other components of the environment) points to assigning responsibility to the causative source, despite there being no legislation on this. This is even more relevant in our country where the right to live in a pollution-free environment is established in the Constitution, without defining how to act in the case of unregulated pollutants.

The worldwide tendency suggests that the need for a firm to be aware of the impacts and effects of emissions arising from its processes is increasingly its own responsibility.

As general conclusions from the discussion of the above concepts related to environmental pollution, the following can be proposed:

- Activities of any type whose operations cause potential impacts on the environment should take action to ensure that the management of pollution problems is technified to the maximum, by defining methods and quantitative procedures. This assigns a role to regulatory institutions and State control.
- The emission of elements into the atmosphere should not be confused with ambient concentrations of the components of that emission and thus with pollution.
- Responsibility for the environmental effects caused by emissions from activities lies with the activities themselves and thus implies the need to undertake research.

Policy Guidelines Proposal for Controlling Environmental Pollution

An environmental policy requires a clear definition of the objectives which it is desired to achieve on environmental issues. These objectives, in turn, must be fully consistent with other goals relating to the country's socioeconomic development.

As was pointed out above, these goals will be dynamic and depend on the quantity and quality of available information and of the weighting of different components of the quality-of-life equation that society defines.

It is therefore not our responsibility to state the objectives that an environmental pollution control policy of should comply with. However, it seems reasonable to assume that one goal that points in the right direction is to maintain and improve basic natural resources (air, water and soil) so as to enable society to develop in harmony with the environment and with the socioeconomic needs of the country.

Another goals that would seem to be clear points towards using the country's commonly owned environmental components in such a way as to satisfy the nation's needs, while at least maintaining their potential to improve the quality of life of society, without exceeding the levels of use/environmental quality defined by society.

As more specific objectives directly relating to environmental pollution, the following can be enumerated:

- Maintain¹¹ air quality at levels defined by society..
- Maintain water quality at levels defined by society.
- Ensure that land is used without causing externalities unacceptable to society.

It must be made very clear that actions on ecosystems and species of flora and fauna, as well as systems for exploiting natural renewable and non-renewable resources, also affect environmental pollution, generally with longer-term effects and in ways that are more difficult to predict—an issue not discussed here given that we are focusing on analysis of environmental pollution.

a) General policies

Society can use the environment to improve its quality of life, so modes and intensities of use must be established, either to protect human health or to avoid negative externalities.

¹¹ We take as a premise that if one tries to improve the quality of environmental resources beyond that defined by society, one would be allocating more resources to this quality of life parameter than to its other components, thereby using scarce resource badly.

To establish modes or intensities of use of the environmental components, air, water and soil¹² it is vital for society as a whole to consider the benefits and costs, direct and indirect, implied by establishing certain modes and intensities of environmental use (different maximum permissible levels or environmental quality standards).

In order to regulate the constitutional right to live in a pollution-free environment, it will be the State's responsibility to propose air quality standards with respect to different protection goals. In the case of public health, the State must also monitor, evaluate and check that the levels (standards) defined by society are not exceeded.

Given the far-reaching nature of the restrictions that can be imposed, it is reasonable that they should only be established by law, so that they become socially validated as regards the use, benefit or disposal of components of the environment in public or private ownership.

These restrictions should not discriminate between different types of activity, unless differences between them relate specifically to the environmental effects they produce. Restrictions should consider relations between different components of the environment in an integral way, along with the relation between the environment and economic and social development needs, as well as ensuring consistency with the rights guaranteed in the Constitution and in harmony with the country's general developmental goals.

In order for the legislated standards to have scientific support and therefore to be efficient in fulfilling the objectives for which they were decreed, research needs to be carried out on the environment, its potentialities and limitations. Given the public-good characteristics of the environment, the State should play a significant role in supporting such research without this meaning agents responsible for environmental pollution being exempted from their obligation to be aware of the impacts their activities give rise to.

Similarly, as regards environmental research programs, actions oriented towards increasing the role of the individual and participation by members of society in maintaining and improving environmental heritage should be developed and supported.

Considering that a large proportion of environmental pollution problems originate in the fact that certain components of the environment are of public ownership, the use of these components should be regulated and controlled, and should not be free, as this leads to overuse of the resource,

¹² These policy proposals will only deal with aspects related to environmental pollution.

thereby exceeding its capacity to absorb effluents and hence causing pollution.

Regulation of the use of environmental resources should consider mechanisms such as the granting of concessions or allocating rights of ownership or use, to allow users stability in the rules of the game so that they can optimize their respective production functions, assimilating the use of environmental resources to that of any other input.

Moreover, this regulation needs to have the technical capacity to monitor compliance with priorities, modes and intensities of use of environmental assets, as well as the standards established for these purposes. Furthermore, there should be clear and replicable technical procedures to permit the objective evaluation of the goals of environmental quality.

For the social decisions on the different components of the quality-of-life equation to be taken with sufficient information, it must be the State's job to explicate and divulge information corresponding to environmental effects, both health and economic effects, that actions of environmental protection, conservation and preservation imply for society¹³.

b) Specific policies

Below we present specific guidelines for contamination of the resources air, water and soil, as well as a brief review of policies for controlling other types of pollution. It is not the intention to cover all aspects of environmental pollution control policy for each of the resources analyzed, but we try to highlight the special characteristics of each one.

—Air

In the case of air, an environmental resource characterized by its difficulty of appropriation, environmental quality standards should be expressed as maximum permissible levels of emission, accountable to specific protection targets.

As air is a component of the environment under common ownership, pollutant emission will require authorization or rights assigned to emitting activities. The manner of assigning these rights may have regressive implications for income distribution between individuals.

The total number of authorizations or rights granted must be based on the maximum permissible levels defined in response to human health

¹³ It should be remembered that conservation means use.

targets, or the protection of any other goal society may desire. In another words, authorization should not be given for more emissions than the atmosphere is capable of dispersing without causing pollution.

For such emissions rights to reflect the real value assigned by each activity to the use of the air resource, they should be able to be traded between owners.

There should be programs to monitor air quality, aimed at evaluating the quality of the atmosphere in terms of the maximum permissible levels established, whatever may be the protection goal.

So as to exploit the comparative advantages of each activity, definition of the specific quantitative restrictions for pollutant emissions, or definition of specific technological processes for reducing them, should be avoided, as it should be the agents involved that decide how to achieve the necessary reductions, except in the case of pollutants with no dose/response threshold.

—Water

In order to regulate the Constitutional right to live in a pollution-free environment, it is appropriate to set water quality standards for different uses in natural water courses and lakes.

Water quality is evaluated with respect to one or more of the quality standards defined by the law. Water qualities thus determined should form part of the attributes of water exploitation rights. Water quality rights should not be below the standard defined by law.

Water quality rights should be able to be traded among their owners, and rights to water exploitation affecting the quality rights of duly constituted third parties may not be granted

The restitution of water, or any other type of discharge into water courses or natural lakes, should not cause the quality standards defined by society for different uses to be exceeded, and shall always be undertaken in such a way as to avoid damaging quality rights duly constituted by third parties downstream. Where water courses flow into the sea or into natural water courses or lakes that constitute goods of public use, the quality characteristics to be complied with by the water course at the point of inflow should be calculated so that the quality of water in these receptor bodies is not affected.

There are substances which cannot be discharged into natural water courses or lakes, or into the sea, given their high level of toxicity.

—Soil

Given that the soil is a resource whose ownership is defined and recognized, the effects caused on it by contamination of the environment should be evaluated in the context of harm to property and therefore follow the ordinary legal processes for resolving this type of problem.

—Other forms of pollution (noise, radiation, vibration, light, etc.).

Like the contamination of air and water there are other forms of pollution that are equally or more harmful to human beings, as well as to flora and fauna among other things. Often such contamination is confused with air pollution for example (the case of noise), but the fundamental difference lies in the fact that they tend to be energy forms which travel through the air, water or soil. The conceptual treatment of such contamination does not differ greatly from the case of air or water pollution, but it should be treated differently when its effect transcends the time scales of human beings, such as the case of radiation. □