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**Article — Digitized Version**

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Intereconomics

*Suggested Citation:* Rohde, Klaus E. (1972) : Ecology in theory and practice, Intereconomics, ISSN 0020-5346, Verlag Weltarchiv, Hamburg, Vol. 07, Iss. 9, pp. 267-271, <https://doi.org/10.1007/BF02929615>

This Version is available at:

<https://hdl.handle.net/10419/138697>

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# Ecology in Theory and Practice

by Professor Klaus E. Rohde, Bonn \*

Many branches of science and technology are currently concerned very closely with the protection of the environment. Destructive and noxious changes in our surroundings, and the fight against them, or for their prevention, on a first and cursory survey, will be seen to raise many-sided problems, which occupy the minds of scientists and technologists, of politicians, of lawyers, and of economists.<sup>1</sup> In all these fields, people are endeavouring to acquire more knowledge and to improve its application to the problems in hand. In this way, protection of the environment, during the twentieth century, adds another one to the big challenges to economics, which is of comparable importance with those of "Big Inflation", the big inter-war slump, the need for economic growth after the World War II, and the objectives of development policy.

## The Urgency of Ecological Efforts

It can clearly be seen how closely the collection of facts, and of their evolution, and the promotion of research are interdependent, when social costs and social gains arising from changes in the environment are being explicitly taken into

account for drafting general norms or solving special tasks by welfare theory. Even in LDCs, both forward evaluations and reviews of past effects of investments use, for assessment purposes, cost/benefit analyses in regard to environmental changes.<sup>2</sup>

Appreciating the systematic way in which the protection of the environment is being planned, these efforts appear, in general, to be praiseworthy because, hand in hand with perfecting the theoretical foundations of this work, both privately and publicly-financed efforts are growing. As witness recent conferences in Santiago de Chile and Stockholm, also international co-operation in this field is being strengthened. On the other hand, it is alarming that, in spite of much more activity in this field, the pollution of watercourses and the sea, and of the natural atmosphere, as well as noise levels in industrialised countries,

are in most cases deteriorating further. In other words, the race between advancing dirt and noise pollution from all sources and the numerous protective and preventive measures is to begin with being lost by the latter, and this is even true for certain regions in LDCs<sup>3</sup>. This creates special problems for the processes of acculturation and economic growth.

Extrapolations reveal an even darker future. According to a recent study of the Massachusetts Institute of Technology an at least tenfold encumbrance of the environment by pollution has to be anticipated in about 30 years – on the assumption of a world population of 7 billion, a high per-head income and present pollution coefficients. Such prognoses are a challenge to inter-disciplinary research and political action.

## Three Separate Levels of Action

If the measures to be taken against environmental pollution are to be efficient and systematic, rational action must proceed along three separate but closely connected levels:

☐ Definition of objectives;

<sup>1</sup> Under these headings, but broken down into more subdivisions, the author has enumerated and discussed, at greater length, the relevant problems and topical strategies, cf. Klaus E. Rohde, "Social Costs in marktwirtschaftlichen Systemen. Theoretische Probleme und aktuelle Aufgaben für die Wirtschaftspolitik" (Social Costs in Market Economies. Theoretical Problems and Topical Tasks). Bonner Habilitationsschrift (Thesis, written for obtaining a Bonn University lecturer's licence), 1966.

<sup>2</sup> cf. "Theorie und Praxis der Evaluierung von Projekten in Entwicklungsländern. Eine Bestandsaufnahme" (The Theory and Practice of Evaluating Projects in LDCs. A Review); by Axel J. Halbach, Ifo-Institut für Wirtschaftsforschung (Institute for Economic Research). Munich, 1972.

<sup>3</sup> A description of this development in one country (whose pattern is similar to that in other parts of the world) is contained in "Environmental Pollution in Iran", compiled by The National Iranian Oil Company, Research and Development Group, presented at the Cento Panel Discussion, March 2, 1971.

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☐ Listing of conditions that are to be changed, and of the available resources; and

☐ Selection of suitable ways and means for optimal achievement of the objectives, including the time factor.

On all the three levels, both programming and practical protection of the environment will always run into numerous pitfalls of difficulties and of distortion. In the following discussion, some of these numerous problems, on each of the above-named levels, will be outlined, because they are of crucial importance but—in the author's view—generally too little known, so that there is not yet a solution to them. We will first discuss the definition of objectives.

### **Planning instead of Self-Regulation**

It is sometimes argued that the damage done to organic life and to material growth, which is caused by a deteriorating ecology, are desirable and necessary in order to reduce the growth potential everywhere. Against this, the following must be stated: though it is true that *ceteris - paribus* - extrapolations lead to frightening forecasts about population growth, about the future density of world motorisation, and of other indices, we believe that it is a methodical fallacy, leading to highly doubtful results, to strive for a kind of "natural equilibrium" through partial self-destruction, on a higher level of civilisation. It is surely to be preferred to increase human knowledge with a view to rational planning, and to use the two as our tools.

Reasoning and political decision-making is, of course, partly paralysed by the fallacy that measures of environmental protection can be had only at a

"price" that is too high, or even "madly" high. Costs of suppressing or preventing external damage are alleged to be much too expensive. There are a number of interested parties who try to persuade politicians, for example, that strict water purifying regulations or the fight against motor exhaust pollution would strangle chemical industry or kill all motor transport. These prophecies of doom are absurd even if it is assumed that present technological knowledge and organisational skill will not grow further. In view of the experience that technological progress, if it is set definite tasks, can, within limits, be deliberately promoted (e.g. through investments in research), their absurdity is towering. Under the pressure of growing competition during the 19th century and of regional integrations of our own time, the fallacy of such arguments was clearly proved.

Similar effects are achieved by making statutory regulations about the reduction of noxious emissions by certain fixed dates in the near future, which will be imposed on investors and consumers alike. Thus, the strict US statutes about decontaminating car exhausts have already forced the motor vehicle manufacturers to develop technically viable and economically acceptable new appliances. Also, in the Persian Gulf it can be seen that the seawater adjacent to some oil terminals has already become much cleaner than in our European seaside resorts. This means that reasonably timed but very strict measures for protecting the environment (and providing for spreading their financial burden as evenly as possible for the period of transition) will not put a brake on the *positive* aspects of technological civilisation.

It is to be welcomed that more and more individuals come to

appreciate that the protection of the environment is necessary in a number of fields, and that it must be strongly increased in the future. That individuals adopt such aims is of great importance for the overall success of ecological efforts, for the environment suffers harm from many sources, and the damage done to it must be reduced at source. In order to make the individual elector responsive to political programmes and to the desired regulations, his receptivity for such ideas is essential.<sup>4</sup> It is actually the individual person whose welfare is threatened today by unbearable noise, the dirty atmosphere, his ugly and noxious surroundings, etc., which he feels as a personal loss. Medical men, psychologists and representatives of other branches of science also tell him that the actual harm done to him, especially in the long term, is frequently much worse than the layman himself may recognise.

### **Increasing Environment-Consciousness**

In LDCs, the process of acculturation is so difficult, not least, because former nomads become settlers and peasants flock to the towns and must get used to a new environment that is totally alien to them. Then the typical misery and chaos of new conurbations reduce the personal welfare of the migrants visibly and thereby persuade them to revolt and to raise exaggerated demands that carry dangerous unrest into the home policy of these countries.

Growing discontent of the population has recently led political parties and governments to base their programmes and their image policies deliberately

<sup>4</sup> In a number of states, it is now intended by their governments and by certain associations and semi-public bodies to make environmental protection the subject of intensive civic enlightenment programmes, e.g. in the schools.

on promises to produce speedy remedies. But it is typical that a number of conflicts between environmental protection and other urgent political aims remain unsolved or are not even seen, which leads to technological and financial difficulties that can frequently not be overcome. The effect is then that many of the promises given can by far not be fully met. There are also critics who assert that the fight for protecting the environment has become so fierce (e.g. in the US) because the government would like to show off its active energy, whereas the mute object of protection is incapable of defending itself, which organised social groups and foreign powers are well able to do.

### External Diseconomies

Visible pollution in our environment—polluted water courses and coastal seas, a dirty atmosphere, unsightly refuse tips, and a measured noise level—are not the ultimate harm done to nature but only a kind of intermediary effect or constellation which, under certain conditions of contact, produces concrete damage in all its manifold forms. To give an example:

$$y = f(x_1, x_2, x_3 \dots x_n; x_{n+1} \dots x_n + z).$$

Output of a chemical plant is y. Under conditions of a given

form of organisation, technology, and location, inside the plant the values  $x_1$  to  $x_n$  will be used up (they are raw materials, paid labour, royalties for licences, etc.). Because unpurified waste water (of a given quantity and composition) is discharged into a river, the fishes in that river die (their value is assumed to be  $x_{n+1}$ ), and among other things, destruction of a bridge through corrosion of some of its parts (its value to be  $x_n + z$ ). This kind of consumption of "external" values has been caused by the chemical output, and under existing conditions of production, this is inevitable. If all other things remained equal, and this external consumption should be suppressed, production would also have to cease. But a rational way out of the dilemma is a change in "all other things", in the following way: (a) production to be reorganised, e.g. by purifying waste water before its discharge; and/or (b) changing the conditions under which the production plant makes contact with the external world, by piping the waste water into a public utility purifying plant, insulating the threatened parts of the bridge from corrosive fluids or vapours, etc.—This implies a modified production both for internal and external factor use, and that is the way in which a policy of environmental protection may operate.

Operable theoretical models which represent highly complex reality with adequate approximation must, of course, never remain as abstract as the example constructed here.<sup>5</sup> For the purpose of decision-making, collection of useful information is a far more difficult task than the purely theoretical description of the problem: to determine "damage" and "responsibility" for it implies already a regulative decision, which will be made before diagnosis is attempted. A demarcation line has to be drawn for every single case between the "normal" and the "abnormal" state. How difficult this is can be seen from the most commonplace examples.<sup>6</sup>

### The Problem of Measurement

If we are not able to gauge the size of social costs or of

<sup>5</sup> For reasons of space, it is not possible to discuss here the voluminous literature about social costs, their theoretical significance, and their consideration in economic policy conceptions.

<sup>6</sup> Gardners on the outskirts of a big city suffer from reduced yields because the surrounding air is full of poisonous fumes from motor vehicle exhausts and industrial smoke. Are they entitled, having once chosen their location, to demand cleaner air? (A regulative decision.) This would make the polluters of the atmosphere "guilty" of causing damage. Does it matter in this context that the peasant farmer in an oasis of an LDC also suffers from annual crop damage, because sandstorms and locusts belong to his chosen location? Or: LDCs which own oil reserves earn rich profits from rising oil production, with which they finance their economic development. Do they leave a beneficial heritage to future generations of their population, or do they do harm to them by overexploiting their natural resources, and do they use the present world oil boom optimally? Without knowing future oil price developments, can we make a decision on this question to-day?

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external diseconomies on the basis of present-day firm facts, we shall also not be able to draw explicit conclusions from them as to the consequences for economic and social policy, either qualitatively or quantitatively. Admittedly, there are some branches of research which offer aids for basing this process of decision-making on more realistic foundations, but there will always remain a rest of arbitrariness in each and every political decision (including the problems of political power), and this will be so in each case of applying cost/benefit analysis. It is important to be aware of this, but it is at the same time slightly discouraging. For it makes the use of the category of "ecological" damage no less and no more suspect than the far more customary ones of "equitable taxation" or of "adequate social security". At any rate, it is necessary to evaluate the quality of the regulatory decisions needed for diagnosing ecological damage also from the point of view of given political conditions and the problems implied by them.

#### Direct Compensation Payments

There is, in principle, the possibility to compensate for the use of external values in production by "rewarding" the losers, or to prevent such use from occurring.<sup>7</sup> "Payment for use" or compensation for damage would have to be rendered, at any rate, *directly and individually*. It must not be evaded by the argument that economising factor costs through transferring them to the environment makes the products cheaper or, in

other words, passes on to the consumers cheaper supplies, in real terms. It is a fact that, generally speaking, this much-favoured way of arguing is partially true, but in the immensely complex processes of demand and supply, it cannot be expected, in real life, that the individual who has suffered from harm done to his environment can claim the approximately true value of the losses sustained through the structure of his consumption. Moreover, it must be stated that the currently widespread practice of political regulatory decisions about environmental protection forbids the compulsory transfer of external damage to nature even if and when individual sufferers from it have a certain chance to claim compensation.

#### Reasons against this Principle

If it is suggested, on the other hand, to force the "guilty parties" to make *direct and equivalent compensation payments*, which will not flow through the process of economic circulation, there are many cogent reasons against adopting this method: many forms of damage, especially grave damage to personal health (assessed on the degree of human suffering for the cost/benefit calculation), cannot be fully made good by money payments. If it happens to-day that factories that pollute the environment are sentenced to pay heavy damages, as in the case of six Japanese chemical works which had to pay the equivalent of about £ 100,000 to people who suffer from asthma because of these companies' noxious emissions, this is only an *ad hoc* distress solution, because the firms involved caused external damage illegally instead of preventing it. There are other reasons for not adopting the principle of volun-

tary compensation for the consumption of external values, e.g. the enormous difficulty of correlating the individual creditors and debtors precisely, because air and water pollution of one single production plant may have geographically very widespread effects and frequently mingles with the pollution caused by other factories.

#### Preventive Measures

It makes much more sense—and most countries tend to use this method—to *prevent, from the outset, and as far as possible, the occurrence of external damage*. To impose new regulations on potential causers of damage, the following procedure has to be adopted:

☐ *The start* is to be made through finding clearly defined groups of persons who have suffered damage, in a clearly delimited locality, who show, e.g., deficiencies of their breathing of a certain severity;

☐ *The causes* of their suffering are to be found, e.g. climatic conditions (which may be responsible in a number of LDCs), smoking tobacco, and aggressive components in the atmosphere;

☐ As soon as an unnatural irritant or poison in the atmosphere has been pinpointed as the cause, it has to be stated which is the maximum concentration of the noxious component to be allowed at the place of its incidence. *To fix such upper limits* from the experiences of scientists and medical men presents formidable problems, especially in regard to delayed health risks, about which frequently too little is known to-day;

☐ *Sources*—mostly geographically widely dispersed and often also vastly diversified—of contamination and pollution are to

<sup>7</sup> Because of the brevity of the discussion required here, the author has only presented simple alternatives, instead of compromise solutions, and does not mention parallel cases, which sometimes, especially in periods of transition, are more realistic.

be found, including various industrial and commercial businesses, domestic heating, motor transport, etc.

□ Finally, regulatory maxima of emission must *reduce the different sources of emission* to that extent that their combined effect, which in some mixtures of pollution is pushed up exponentially, remains *below the regulation limit* in a given locality.

It can easily be imagined how enormous are the theoretical and practical difficulties to be overcome on each of the named stages of prevention, in order to make it effective. It is indeed often necessary to revise the findings of the various branches of research on which environmental protection is based. Though statutory rules and regulations on various subjects of ecological protection exist to-day in great profusion in many countries, their effectiveness, measured by their success, is mostly insufficient. This has both immaterial and many other typical reasons.

For the reasons stated, it is often very difficult to *draw up* efficient ecological measures,

but there are also many factors hindering their effective *application*. Before they can be largely eliminated, they must become known. Some of these obstacles are:

#### Obstacles to Environmental Protection

□ Local authorities and governments sometimes compete with each other in offering mitigation of environmental protection rules in order to attract industrial investment, because of its taxable capacity.

□ Ecological programmes are partly abolished (temporarily or permanently) or suddenly modified because their methods do not appear in line with the cyclical trend or growth-promoting<sup>8</sup>.

□ The above-mentioned conditions for causing external damage remain as unfavourable as

<sup>8</sup> On the subjects of social costs and economic growth, there is a voluminous theoretical literature and also much on their practical economics. Public investments for the infrastructure of environmental protections may in some cases even revive lagging economic growth; cf. Umweltschutz und Wirtschaftswachstum; Papers presented and seminary results at the First Symposium on economic and legal problems on environmental protection at the University of St. Gall, Switzerland, October 1971; ed. M. P. von Walterskirchen, Frauenfeld and Stuttgart, 1972.

they always were or even deteriorate, instead of improving and giving support to ecological measures at the sources of emission<sup>9</sup>, for example: Main through-roads are built right through residential areas, which makes contact between many people and motor exhaust fumes particularly close.

□ Polluters of the environment, when confronted with the new regulations, do not understand fully what they mean, or because they are technically unclear, cannot change over with sufficient speed to the new statutory emission ceilings. To change this, educational campaigns by industry associations, chambers of industry and commerce could improve their understanding.

□ To maintain their national and international competitiveness, companies ignore the new prescriptive rules, because they increase the costs of production. This causes the typical gap between legislation and law enforcement, but this may be narrowed through supra-national strategies.

<sup>9</sup> This is a particularly important point of departure for rational integration of town and country planning for environmental protection.

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