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COMPOSITE ESTIMATES OF ENVIRONMENTAL POLLUTION AS A PART OF ENVIRONMENTAL PLANNING

The author discusses problems of improving the planning of environmental protection. Attention is focussed on air protection measures. The prevailing situation in environmental planning is characterized on the level of national economy. The importance of improving the supply of information by means of creating up-to-date information systems in the field of environmental protection is stressed. The necessity to apply comprehensive composite indicators of environmental pollution in combining territorial and sectoral aspects of environmental planning is shown.

1. Introduction

At different levels of environmental planning and management initial information with highly different degrees of generalization is required. In some cases a general, integral survey of environmental pollution is needed while in other cases the air or water pollution level caused by some given pollution source down to single contamination indicators might be required. The efficiency of pollution abatement measures depends to a large extent on their correct choice, temporal succession, scale of application, and, last but not least, checking the results achieved.

A general characteristic of pollution is that it always occurs in some concrete district and is caused by the production enterprises (units) of one or another ministry located in this district or some neighbouring one. However, the planning of the pollution abatement measures in a sector is still carried out centrally, at that only selfish growth interests of the sector are considered with no attention paid to the existing pollution of the region. Combined sectoral and territorial planning with the latter playing the leading role has not been widely used in the national economy planning in the Soviet Union. This year one more economic experiment in the field of environmental protection is being prepared in the Estonian SSR, in the course of it the focus of planning pollution abatement measures will be transferred to the regional (union republican) level, to be more concrete, to the district where the worst polluters are located.

A state plan for reducing the pollution of the air or water bodies of some region or district is still a mechanical combination of the plans of the enterprises of different ministries, not an intercoordinated set of measures aimed at pollution abatement in the region. Administrative requirements set by territorial authorities to pollution abatement are the last to be considered (if considered at all) by sectoral ministries, especially all-Union and Union republican ones. As a result, the effect is smaller than expected.

Besides insufficient use of administrative and economic measures affecting environmental pollution, a notable reason for unsatisfactory results of environmental protection efforts lies in the lack of comparable composite estimates on the state of the environment, especially air pollution. In some countries the need for composite estimates of environ-

ment was understood more than ten years ago [1, 2]. Accordingly, a number of techniques have been developed for making comprehensive estimates [3, 4]. Their majority make use of expert estimates to order different aspects of pollution according to their importance. One of the most important goals of developing composite estimates is the determination of the order of territorial units according to the level of pollution to most efficiently allocate the always scarce resources.

Below the necessity to develop composite integral estimates of the state of the environment for environmental planning is discussed.

2. Composite estimates of environment in the planning of national economy

For a successful development of national economy, maintenance and reproduction of people's health and mental and physical ability to work it seems to be indispensable to preserve a certain quality of environment. The planning of the exploitation of natural resources and environmental protection started in the Soviet Union in 1974 does not make direct use of estimates characterizing the state of environment and indicators of the quality of environment. So far the plan targets in the field of environmental protection are but indicators of material expenditures aimed at achieving a recommended, normative state of environment, or indicators of the reduction of emission summed up for the whole region, union republic, etc. under study. As to their objective, these indicators are oriented toward pollution abatement, however, indicators showing the efficiency of the measures taken, those of feed-back between plan targets and changes (improvement) of environmental quality in the form of composite estimates are still lacking.

Comparisons of single parameters characterizing the state of the components of environment — air, water, soil, etc. — with the preassigned standards are used as empirical, calculational aids for simplified solution of certain problems. However, such comparisons have not been developed into an orderly system, and so no estimates of the existing state of environment, not to speak of forecasts, are included in the state plans of the development of national economy at present.

Problems connected with rational exploitation of natural resources and environmental protection have become increasingly more topical during the recent five-year-plan period, and their importance is still growing. In this field of planning and management the lagging behind of our information processing facilities as well as the lack of automated environmental monitoring and control systems is having an increasingly stronger braking effect.

The use of such automated systems is especially advantageous in optimal planning and management of large systems — like modern environmental protection in its diversity in the Estonian SSR.

It has become clear that the ever increasing volume of information makes it necessary to considerably cut the time needed for processing of technological, economic, social and ecological data, and decision-making. By data processing we refer here to the collection, systematization, generalization, etc. of primary information. At the same time it is indispensable to raise the scientific substantiation of planning and management decisions. Scientifically substantiated decisions in the field of the exploitation of natural resources and environmental protection must be based on the methods of comprehensive analysis, estimates and forecasts and application of up-to-date computing equipment that is organically combined with a system of high-quality expert estimates. As a rule,

the decisions should (as an ideal) be optimal, i. e. they should be the best ones under the preassigned (e. g. environmental) constraints, they should yield the extreme value of the resulting phenomenon serving as the objective function.

It seems to be impossible for national economy to function without the exploitation of natural resources and emission of pollutants. Consequently, the problem of optimizing the system of the interrelationships of nature and society consists in the creation of the most favourable conditions for economic and social growth avoiding at the same time progressive degradation of natural environment [5].

The problem cannot be approached in a narrow economic context, i. e. as the achievement of maximum results with minimum expenditures. The expenditures made to quarantee rational exploitation of natural resources and preservation and improvement of the quality of environment are as significant and indispensable as all the other expenditures of the economic and social (culture, education, health care, etc.) spheres. As a matter of fact, the rational exploitation of natural resources and environmental protection are closely intertwined with both of these spheres, lying as if between them. We have not been able to develop an efficient and reliable system of indicators for planning and accounting purposes or generalized efficiency indicators which would allow us to connect everything vital with the material sphere ensuring the development of society.

Environmental protection, problems of the quality of environment and especially generalized assessment of the state of environment have not been given due attention to in the prevailing approaches to the planning and management of national economy. The terms like "the quality of environment", "comprehensive assessment of the quality of environment", "pollution level of air and water bodies", etc. have so far remained in the realm of a few research efforts. Practitioners — environmental protection planners, supervisors, inspectors and conservationists — are using several different interpretations of how the pollution level of one or another component of the environment (air, water, soil, etc.) might be assessed.

There is neither experience nor a good theory for estimating crowded residential environment or the quality of life in general side by side with such parameters of the social sphere as satisfaction with services, sufficiency of greenery, availability of recreational facilities or crowding (the term used by our environmental psychologists to designate mental stress due to overcrowdedness) [6]. In a generalized system of social value estimates the parameters of the quality of environment are no doubt but part of numerous possible parameters.

In the field of the planning and management of national economy one possibility to improve the situation would be to compile the environmental protection plans of the industry on the basis of comparable and generalizing comprehensive estimates of the quality of environment. This would significantly raise the importance of the territorial aspect of the planning and management decisions both on the level of the whole national economy and a single industry, would help them to reach their direct addressee — a pollution source located on a certain territory, and local ecological-economic peculiarities would thus be taken into consideration.

To plan air pollution abatement (e. g. to the set standards) a territorial survey is needed of the emissions[1] as well as immissions[2] of major pollutants in bigger towns and industrial centres. On their basis comprehensive estimates of air pollution are compiled which take into conside-

[1] emission — the quantity of pollutants emitted into the air by a pollution source in a unit of time.

[2] immission — the content of pollutants in the air formed as a result of their diffusion, transformation and transfer.

ration major pollutants, their different health hazards to human organisms (in the future also to vegetation, buildings, and other components of environment), harmful effect, etc. The assessment of comprehensive estimates is based on the principle of normative assessment of air pollution on the basis of a system of single pollution indicators. A comprehensive composite estimate — air pollution index is obtained by the reduction of single pollution indices or immission indices by means of sanitary-hygienic standards, maximum permissible concentrations, and by their subsequent aggregation into a dimensionless synthetic index. The use of comprehensive estimates would facilitate both environmental planning and day-to-day control and regulation.

A composite air pollution estimate would serve as a basis for developing a set of pollution abatement measures on different levels of territorial division. Proceeding from the principles of combining sectoral and territorial environmental planning a technique has been worked out for determining a set of air pollution reduction measures and their order in bigger towns and industrial centres where the number of pollution sources is about 300 [7]. By means of optimizing the territorial composition of various measures the set of measures which will yield the greatest reduction of the immission of one or another pollutant in case of fixed expenditures is found. At that the measures available at the present technological level in the Soviet Union for pollution abatement (construction and reconstruction of purification facilities, modernization of the technological process, use of alternative fuels or raw materials, etc.) and their cost is known beforehand (for the most important pollution sources).

Several converse and conjugate problems can be formulated here. For example, if a problem is set for reducing the emission of pollutants to a preassigned level or to achieve emission standards, it is possible to find the set of measures required and its cost. The final choice of an optimal solution is made on the basis of the set of measures by means of expert coordinations within the framework of compiling the development plan of the national economy. Such a system for the territorial planning of the measures of analyzing and reducing air pollution is being modelled on a computer with reference to the Estonian SSR and Tallinn.

3. On the need of composite estimates of air pollution on different levels of territorial planning

On the level of decision-making where pollution abatement measures are planned within the framework of national economic plans integrated estimates of the air pollution level are required as initial information. At that, estimates of different degrees of generalization are needed as the planning of the respective measures is conducted on different hierarchical levels.

First, pollution estimates of regional (union republic) level are undoubtedly required to make comparisons with other regions. In the Soviet Union surveys of air pollution are systematically drawn for about 500 cities and industrial centres. They comprise tens of thousands of single pollution indices as well as values of various other parameters, e. g. meteorological ones. Paradoxically enough, these surveys do not have any uniform assessment criterion or a composite index integrating all the single pollution indices and thus enabling to compare oblasts, union republics, cities and industrial centres. This makes it difficult, if possible at all to arrange different regions in order of their pollution level, the volume of investments needed to reduce it to standards, or the urgency of creating a more favourable fuel consumption structure.

On this level it is above all measures with strategical goals that should be planned for pollution abatement. In Estonia changes in the fuel consumption structure toward increasing the share of less contaminating fuels might be one of such measures. So, in 1986 the share of natural gas in our fuel balance was but 9.8 per cent, while in the neighbouring union republics of Latvia and Lithuania as well as on the average in the Soviet Union it amounted to 35 per cent. Estonia is lagging behind in the construction of branch pipelines of the gasmains: as of Jan. 1, 1986, the total length of branch pipelines was 38 km in Estonia, and 417 km in Lithuania — that is 11 times longer! [8]. However, a dense network of branch lines is a prerequisite for an extensive use of natural gas in power engineering, municipal economy, agriculture and transport. More extensive use of natural gas would considerably reduce air pollution.

Secondly, composite pollution estimates are required on the level of a district and a town to get a picture of conflict situations formed in the given area (for greater detail see [9]), their distribution, hazardousness and other specific features. The use of composite pollution estimates of district and town level in making planning decisions renders it possible to more efficiently and simultaneously also more objectively plan concrete pollution abatement measures, and to determine their priorities.

The existing rather deficient amount of information allows us to make but highly approximate estimates which show that the North-Estonian towns (Kohtla-Järve, Narva, Kunda) and districts (Rakvere, Kohtla-Järve) as well as the capital Tallinn have relatively higher levels of air pollution than other parts of the republic. However, we need more definite and larger numbers of quantitative indices where specific pollutants of e. g. the fuel and chemical industries are involved. Though at present we are able to assess the air pollution of Tallinn on the basis of the average annual immission of twelve pollutants, and that of Kohtla-Järve on the basis of eight to twelve ones, it has still not been possible to compare the two cities objectively on the basis of composite quantitative indices. Moreover, considering the advanced oil-shale chemical and fuel industries and power engineering in Kohtla-Järve, the immission of at least 20 most hazardous organic compounds not measured regularly at present should be taken into account when estimating its air pollution. Well-substantiated pollution estimates that create the necessary prerequisites for keeping the air clean with the help of capital investments and other expenditures could be obtained only then.

At present practical decisions made in Estonia as well as in the Soviet Union as a whole are based on the temporary methodology worked out by the USSR State Committee of Hydrometeorology and the Control of Natural Environment and A. I. Voyeikov General Geophysical Observatory on the making of generalizations about air pollution and emission of pollutants into the air. The latest version of this methodology refers but to four major pollutants — dust, sulfur dioxide, nitrogen dioxide and carbon monoxide on whose average annual content in the air the comprehensive air pollution estimates are based.

It is obvious that if such a small number of pollutants are considered there will be the danger that an incidental (maybe even quite nonessential), eclectic characterization of the situation is given that may serve as initial information for drawing up environmental subdivisions of large state plans. Comprehensive estimates involving tens of pollutants would make a considerably more reliable and objective information base. For the compilation of such large-scale strategical plans vital for the republic like the ESSR long-term environmental protection programme of the scheme for the development and location of productive forces in the Estonian SSR and its chapter devoted to environmental protection, comprehen-

sive generalized estimates are needed to describe the state of different components of the environment.

To come back to different levels of generalized air pollution estimates, the third, lowest level, that of a city district or a certain part of a larger industrial region should be mentioned. In territorial planning the answers to concrete questions — which city district has cleaner air (or environment in general), which are more heavily polluted — are often needed to make correct decisions about the location of health or child care institutions, the necessity for a green buffer zone to lessen the hazardous effect of polluted air, etc.

A generalized survey of the air pollution level in different parts of towns is apparently needed also by the ESSR State Air Protection Inspectorial Office as a supervisory body, and city or district executive committees as executive bodies. The lack of quantitative criteria reflecting the prevailing situation objectively may result in a low efficiency of these bodies in day-to-day control and planning of air pollution abatement.

At the Institute of Economics of the Academy of Sciences of the Estonian SSR an original technique for generalized comprehensive assessment of air pollution on different levels of territorial division (region, city, city district) has been developed by the present author. An integral indicator has been worked out by the synthesis of methodological approaches of several sciences. This indicator seems to be capable of meeting the requirements of different planning and management levels of national economy. For the practical use of composite indicators universal computer programmes have been created for the Robotron 1715 personal computer facilitating considerably their use in practice.

4. Concluding remarks

The necessity to make composite integral estimates of environmental pollution has become obvious on different levels of decision-making. Composite estimates are needed for compiling national economic plans, in design institutions and offices engaged in practical supervision of environmental protection.

Several states have understood the need of composite estimates of environmental pollution years ago, and so a number of systems for drawing up composite estimates have been devised. The Soviet Union began to take interest in composite estimates of some components of the environment in the early 1980s. On the one hand, by that time it had become necessary to orient economic activities toward achieving certain environmental standards or final qualitative indicators. On the other hand, specialists in environmental protection had gained some experience in assessing sanitary-hygienic standards of certain components of the environment, and were able to measure pollution.

A survey of Soviet literature on composite estimates of environmental pollution allows us to conclude that the methods suggested are rather heterogeneous. Some methods are extremely complex and applicable in a limited area only, while others, on the contrary, are simplified to such an extent that they may distort the state of affairs. No generalized estimates are being applied in the practice of environmental planning either.

To sum up, we can say that we have practically no composite indicators meeting the requirements of the planning and management of environmental protection — an ever increasing area of the national economy.

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KESKKONNA SAASTATUSE ÜLDISTAVAD HINNANGUD KESKKONNAKAITSELISE PLANEERIMISE KOOSTISOSANA

Keskkonna saastatuse üldistava integraalse hindamise vajadus on käesolevaks ajaks muutunud selgelt tajutavaks rahvamajanduse kõige erinevamatel juhtimis- ja otsustustasanditel. Üldistatud hinnanguid vajatakse niihästi rahvamajandusplaanide keskkonnakaitse osade koostamisel, projekteerimisorganisatsioonides kui ka saastatuse praktilise järelevalvega tegelevates ametkondades.

Artiklis on vaadeldud keskkonnakaitse valdkonnas väljakujunenud tootmisharu huvidest lähtuva planeerimise olukorda ning selgitatud tootmisharulise ja territoriaalse planeerimise ühitamise tähtsust keskkonnakaitses. On esile toodud keskkonna monitooringu ja infotöötlussüsteemide loomise vajadust ning põhjendatud üldistavate hinnangute kasutuselevõtu otstarbekust Eesti NSV rahvamajanduse planeerimisel. Lähemalt on käsitletud õhu saasteseisundi hindamist. Põgusalt on tutvustatud Eesti NSV Teaduste Akadeemia Majanduse Instituudis atmosfääri saastatuse kompleksseks hindamiseks väljatöötatud originaalset metoodikat.

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Тийт КАЛЛАСТЕ

ОБОБЩАЮЩИЕ ОЦЕНКИ СОСТОЯНИЯ ОКРУЖАЮЩЕЙ СРЕДЫ В ПРИРОДООХРАНИТЕЛЬНОМ ПЛАНИРОВАНИИ

В статье рассматриваются вопросы совершенствования природоохранительных мероприятий. При этом упор делается на охране атмосферы. Подчеркивается, что народнохозяйственное планирование охраны окружающей среды должно быть основано на единстве территориального и отраслевого аспектов, на развитии информационного обеспечения путем создания современных информационных систем, а также на применении обобщающих показателей. Сложившаяся практика планирования и управления указывает на необходимость создания единой методики комплексной оценки загрязненности воздуха. Такая методика разработана в Институте экономики АН ЭССР. В статье кратко описываются основные ее принципы.

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