WATER RESOURCES MODEL: ENVIRONMENTAL MANAGEMENT AND FUTURE BIOPOLITICS

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Ecological and economic optimisation of protective measures at the international or regional/watershed level is today a basic concept of research and projects on environmental impact assessment and environmental education. Thus, approaches and criteria have been developed to estimate interactions between individual industrial, communal or agricultural units and the environment, taking into account mutual effects within one watershed or region.

New approaches to environmental management are to be developed for environmental issues in some regions, or basins, where the economic and social interests of border countries overlap.[1,2] The first basic principle of inter-governmental interactions is based on bio-legislation ensuring the rights of bios. Thus both economic development and bio-environmental protection is provided in the region. Both economic development, and bio-environmental protection would be promoted. Both grounds, and limitations of economic development in every frontier state are set by the environment.

The second principle is based on a strategy of pollution prevention and a more harmonious relationship between ecology and economy at the international level within a basin, which is a concept of clean production. Every frontier state includes improvement of life quality and natural resource conservation into a profit concept as a measurable component of its well-being.[3,4]

The third principle predetermines a new style of life and relationships among frontier countries. It suggests international regional co-operation based on integrated environmental criteria and standards, which determine regional biopolitics. Priority production in every frontier state would be set taking into account interests and demands of the regional bio-environment.

The fourth principle suggests the quick and efficient distribution of biopolitics information within a region, based on communication lines and data banks on bios issues and problems.[3,4] These principles determine regional biopolitics to a great degree.[1,2,3,4,5]

Table 1. Matrix for regional rationing of industrial discharges into aquatic bodies

Action	Material and energetic results	Economic evaluation
environmental, political, social, technical, economic	water conditions, sanitary and chemical conditions, protection measures providing maximum ecological loading limit (MELL)	price, quantity, detriment pre-estimation
aquatic ecosystem	natural formation reservoirs, water quality process, bioproductivity, regulated interaction within the system	economic optimisation based on direct realisation and intensification of water self-purification processes
human	improving industrial technologies, material energetics and biological process control, decrease of natural resources, energy specific consumption, decrease of waste and discharges	ecological and economic optimisation of nature use and ecosystem stability
natural resources	effects on aquatic ecosystems and on reservoir bioproductivity, resource effects on PM and anthropogenic loading	function of natural resources exhaustion in natural resource economics
information	data banks on sanitary, chemical, and hydrobiological conditions, pollution, estimation of material transition coefficients, flow composition monitoring and biotesting	prevention of detrimental effects by PM realisation and PM efficiency
model	determinate and stochastic models for aquatic ecosystems, self-purification statistics	modelling to determine minimisation costs at maximum

		ecological effects
time	dynamic equilibrium between biotic and abiotic components, analysis of new ecosystem conditions under human loading	comparison between advantages of factory operations and costs in terms of environmental changes
control	self-purification and cleaning	efficiency due to optimisation
controllable water removal	specified cleaning effects, change of flow material mass	economic efficiency under dynamic conditions
non-controllable water removal	water removal of flows with specified cleaning degrees, outlet design effects	factory-aquatic object optimum parameters for specified conditions
nature protectioncomplex	environmental management within specified range, specified range of permissible loading	provides MELL rates at minimum costs

The structure of regional international standardisation of human impact on the environment is shown schematically in Table 1. This scheme shows that structures of all components in the system "human impact-watershed-water ecosystem," i.e., man, resources, environment, information, models, time, regulation and water use system as a whole, are to be determined for the development of an integral scheme of water use and protection in some watersheds. Water protection projects, based on predicted maximum permissible ecological loads and advanced technologies - considering social and political conditions and technology and economy criteria - allow the creation of a system of relationships between user and environment, which represent the environment, predict its features, represent the system itself and the efficiency of rational resource utilisation.

In the regional/watershed system, all eight components/categories - man, material, engineering system, environment, information, model, time, control - are elements of every individual subsystem of a water protection complex (WPC). The amount of WPC alternatives is equal to the total product of the amount of quality/nominal values and indicators at all levels. In general, multicriterial tasks are to be solved under existing restrictions, followed by isolation and analysis of a great number of variants, which are optimal by some criteria, and by the construction of an integral indicator. Such an approach would allow use of a single methodology not only to choose some main alternatives for WPC structural elements, but also for WPC research, design, and operation.

At the investigation stage, properties of categories and general scientific concepts are considered, so that they can be distinguished and described with the purpose of morphological estimation and presentation in the form of morphological tables. Such tables may be constructed for the WPC: design stage, comprising learning selection, design, account selection and account design; construction stage, comprising adaptation, use, construction change, addition, adaptation and account realisation; and, operation stage, comprising functional use, operation, and account operation. This would allow a look through possible alternatives of water protection complexes, which realise the above mentioned stages (Figure 1).

Experiences on standardisation of permissible human impact show that it is advisable to use both deterministic, and stochastic models based on laboratory or field studies. Mathematical models are the most powerful facilities for environmental predictions. Mathematical model selection is mainly governed by inter-governmental goals, tasks, and prediction periods, as well as the available informational base. According to the method of description of general relation-ships between contributing factors, one can distinguish between deterministic models and stochastic models (Figure 2).

Within this framework, the following water protection tasks may be solved: standardisation of water removal from one industrial unit or a set of industrial units within a watershed; summarisation, systematisation, and estimation of data

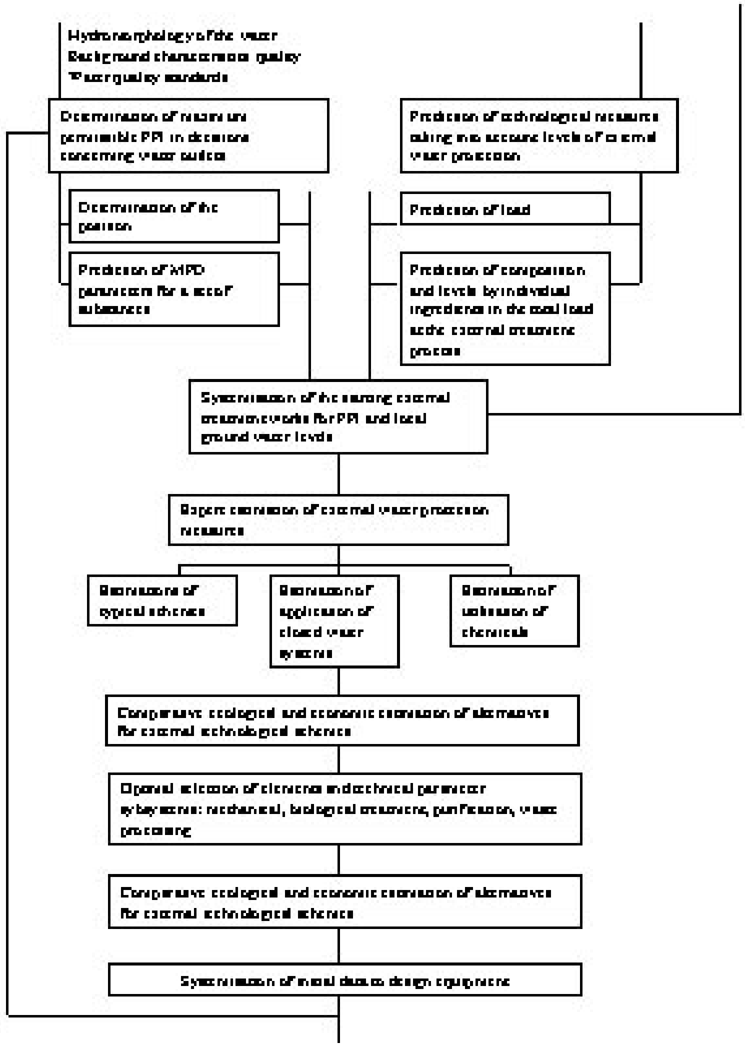

Figure 1. Relationships among different stages of environmental protection

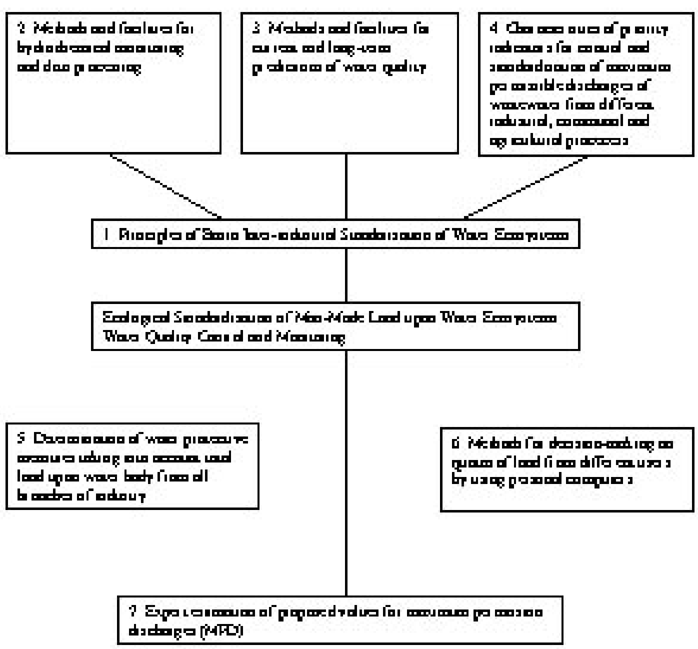

Figure 2. Interrelated methods and facilities for the standardisation of anthropogenic loads on water ecosystems

on water use for a given territory or industrial branch; optimal development of water use systems; optimal state politics of water protection investments; automated construction of integral indicators, and revealing representative indicators of quality for different flows and for the bio-environment; integral estimation, automated classification of surface water quality and pollution source identification; construction of stochastic models for main units of water removal systems, or water body production; feasibility study for maximum permissible discharge in the framework of automated design of water protection systems; inter-governmental environmental assessment of water protection.

A regional inter-governmental information and environmental prediction system (RIIPES) can provide information on: optimal inter-governmental policies for environmental investments at the regional level; selection of ecologically and economically optimal protective measures for individual agricultural and industrial units and water users within a whole basin; prevention of damages. Today, methodology for the function of RIIPES has been developed, taking into account available information support and knowledge, hardware and software for data bank construction and operation, and software for machine modelling and the prediction of water-use systems. The main goal is the establishment of an inter-governmental regional network, including different industrial branches and using a single technical policy.

According to the Biopolitics International Organisation,2,3,4 modern society has to consider profitable production and bio-environment protection as goals complementing each other. Therefore, concepts on bio-environment, conservation of resources, and improvement of life quality are to be part of the profit concept. Bio-environmental management is to be based on improved regulation of the environment, and pollution prevention using economic and legislative approaches.[2,3,4]

Economic and legislative approaches to environmental management involve development of both positive and negative stimuli for bios protection. Thus, environmental degradation can be prevented, or some measures for the mitigation of environmental impact can be stipulated. In this case, environmental protection and development of industrial, communal or agricultural enterprises will complement, and not contradict each other.[2,3,4]

Biopolitics approaches to environmental management have to provide legislation for bios rights and its realisation, prevent further environmental degradation, and ensure compensation for environmental degradation caused by human activities. Assessment of enterprise ecobalance - cleanness - and transformation of society losses into enterprise expenses is now of great importance, because this stimulates changes in enterprise/environment relations. Now it is obvious that both economic development and bio-environmental protection is already stimulated. No product is regarded as a high-quality one if its production does not take into account bios protection requirements. In this case, expenses for mitigation of environmental impact become a part of the ecological balance. Such an approach allows the attainment of environmental goals in parallel.

Based on the B.I.O. Bio-syllabus, a new concept on inter-industrial standardisation of human environmental impact within a whole region or catchment area has been developed. The first principle of inter-industrial standardisation of discharges is based on: the best technologies achieved or expected throughout the world; specific discharges per unit production, comparable to the best world values; local standards for maximum permissible ecological load by selected limiting or representative indicators.

The second principle of standardisation within a whole region or catchment area provides water ecosystem stability based on: thorough studies; application of predictive physical and mathematical models; improved water quality estimation and classification, and hydromonitoring as a whole; development of methods for intensification of natural self-purification, and for quality control over natural water as a habitat.

The fastest way to environmental impact mitigation can be defined using systems analysis of all factors ensuring effective, in accordance with international standards, interactions of all elements in the enterprise/environment system, and an integral approach using inter-industrial discharge standardisation, within a whole region. The solutions obtained will naturally be some compromise between desired results and capacities. The research shows that most industrial, communal and agricultural enterprises have a considerable ecological reserve, which would allow them to meet local standards for maximum permissible load in the future, due to improved technologies and a great decrease of water consumption per unit production, and also improved water removal systems and technologies.

When formulating tasks and making numerical experiments, special attention should be paid to different kinds of interacting human impacts from industry, domestic units, and agriculture[5,6,7] - determinate, temporary, or stochastic. A great number of alternatives are to be considered in order to stipulate permissible load levels, taking into account determinate human impacts only - changes in hydrological, hydrochemical, hydrobiological, and hydrothermal conditions, as well as changes of aquatic fauna and flora.

A number of alternatives need to be considered during design and construction of protective systems, providing permissible load level and taking into account temporary human impacts equal approximately to the number of details under consideration7 - characteristics of wastewater and pollution, emer-gency discharges, disturbances in water protection zones, types of outlets, background levels, total impacts to flora and fauna.

Operation of a water protection complex would provide a stipulated load level, taking into account stochastic human impact - chemical, biological and mechanical pollution, natural organics, biogenics, bacterial pollution, pesticides, oil, artificial organics, change of organoleptic properties. According to a regional or watershed approach, standard levels of maximum permissible discharge are to be developed for every pollution source (Figure 3).

Figure 1 shows that calculated quota can be provided, taking into account non-linear relationships between the cost of external and local works and pollution concentration after those works. Thus, one can calculate minimal cost to meet given ecological standards. When considering watershed areas with several pollution sources, the task is to be solved using an integral accounting approach for selected areas. The cheapest purification system is to be suggested for every possible level of water quality for the area under consideration.

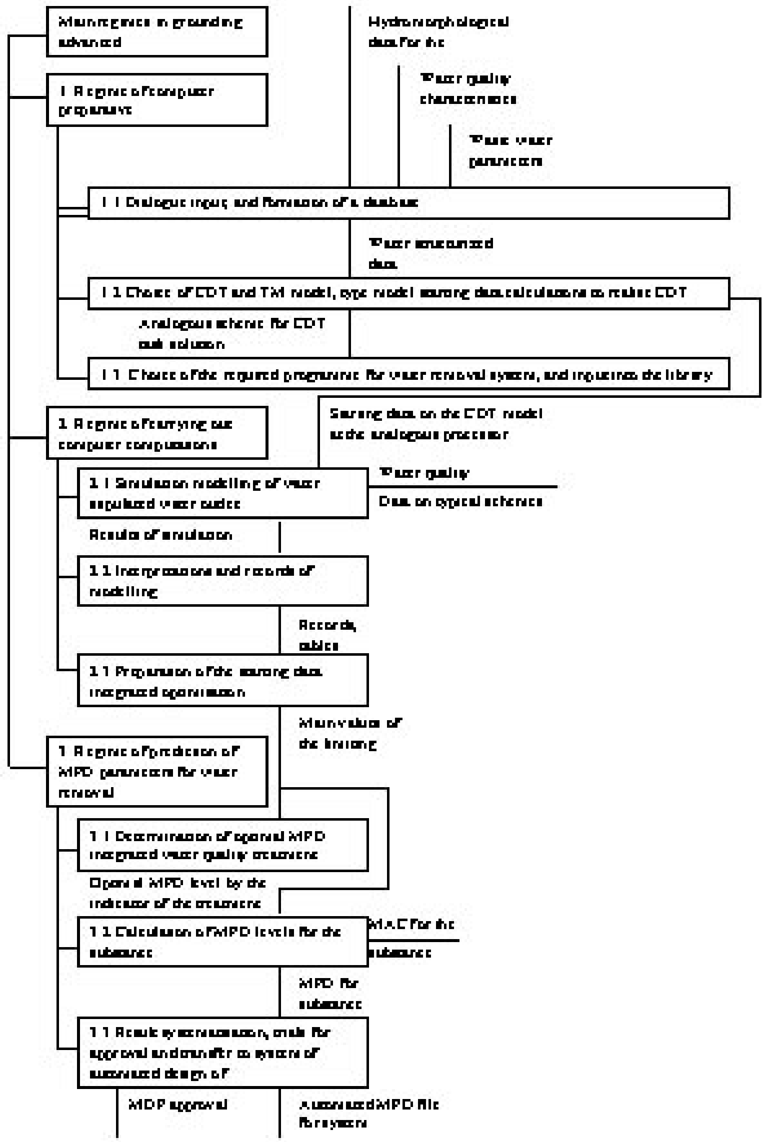

Figure 3. Relationships among stages and tasks in advanced MPD processes

The water purification system of the second outlet is to be suggested for the next downstream area for every quality level, starting from the required level for that area. The purification degree at the previous stage, which provides the minimal total cost of purification, is also to be suggested. Thus, purification works of minimal cost are situated at the second area to provide ecological standards, which would meet the requirements for cleanness at the previous stage, too. Similarly, the best water protection system is to be developed for m areas, and the results of the previous stage being used for every nth area.

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