



**Task Force for the Implementation of the Environmental Action Programmes for
Central and Eastern Europe (EAP)**

**BACKGROUND PAPER ON VALUING ENVIRONMENTAL BENEFITS AND
DAMAGES IN THE NIS: OPPORTUNITIES TO INTEGRATE ENVIRONMENTAL
CONCERNS INTO POLICY AND INVESTMENT DECISIONS**

**Ministerial Consultation between Economic/Finance and Environment Ministers on
Water Management and Investments in the NIS
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This paper, prepared by the World Bank, analyses the economic benefits which can result from effective environmental policies and proposes how these analyses could support decision making in the NIS. It supports Agenda Item 2.

ACTION REQUIRED: For Information

BACKGROUND PAPER ON VALUING ENVIRONMENTAL BENEFITS AND DAMAGES IN THE NIS: OPPORTUNITIES TO INTEGRATE ENVIRONMENTAL CONCERNS INTO POLICY AND INVESTMENT DECISIONS

I. INTRODUCTION

Background

1. At the “Environment for Europe” Conference held in Aarhus in June 1998, environment ministers stressed the critical importance of integrating environmental considerations into sectoral and economy-wide policies to enhance environmental improvement in the region.
2. Recognizing that major decisions affecting the environment in transition economies are being made outside the environment ministries, the EAP Task Force emphasized the need to improve the dialogue between environmental authorities, at all levels of government, and their counterparts in other national ministries, in regional government and at the municipal level who are involved in making decisions on public investments. Awareness of the value of environmental improvements and the costs of degradation appears to be a critical factor for motivating other ministries to consider the environmental impact of proposed restructuring initiatives. That is why the Task Force members approved a special activity designed to enhance local capacity to use environmental valuation in decision-making in the NIS.
3. The World Bank has taken the lead in implementing this activity, which consists of three phases:
 - I. Review of recent efforts to apply modern valuation methods for assessment of environmental benefits and costs in the economies in transition;
 - II. Training of technical experts and decision-makers in applying modern environmental valuation methodologies and assessing their suitability to the NIS context;
 - III. Pilot studies supported by international experts to demonstrate the potential of environmental valuation, both as a tool in the decision-making process, and as a means to improve skills through on-the-job training.
4. This paper summarizes the findings of Phases I and II and reports on the progress of two pilot studies under way. It illustrates ways to improve the process of prioritizing public investments through consideration of the monetary value of the costs of environmental degradation and of the benefits of environmental improvements.

5. This paper consists of six sections. Section II of the paper discusses the potential advantages of using economic valuation of environmental impacts to prioritize problems and to agree on cost-effective means to resolve them. Section III illustrates recent experience and discusses technical and institutional constraints on application of modern valuation methodologies in the NIS. Section IV describes the potential role of environmental valuation in decisions concerning water supply and water quality. Section V describes the progress of the pilot valuation studies undertaken under the EAP Task Force Program for the NIS. Section VI offers conclusions and recommendations.

The key message

6. The economic value of health and productivity benefits of environmental investments is often overlooked during appraisal. This delays financing of projects which, by preventing further deterioration of human health and natural resources, could bring about substantial savings to society. However, well-developed, tested methodologies for estimating the economic value of environmental costs and benefits exist and can, with certain limitations, be applied in the NIS.

7. Evaluating environmental impacts in monetary terms can enhance the ability of environmental authorities at national and at local level to hold meaningful dialogue with economic and finance ministries on the cost of environmental degradation to the national economy and on budget allocation to environmental improvements. Public awareness of the value of environmental benefits and costs can also improve understanding of the trade-offs between environmental and other investments and help in the process of prioritization.

II. ECONOMIC VALUATION AS A TOOL FOR INTEGRATING ENVIRONMENTAL CONCERNS IN DECISION-MAKING

Economic Valuation can help decision-makers faced with difficult trade-offs

8. NIS economies share a number of common characteristics, which make environmental protection a highly controversial issue, ranked relatively low on the political agenda. The environmental disruption that took place in the past is widely acknowledged, and continues to cause severe damage. But people and firms tend to consider environmental damage a secondary problem compared to the other hardships of the transition period: high inflation, persistent unemployment, lessened social cohesion, financial arrears, adverse terms of international trade, and political instability, to name just a few.

9. Popular conviction that the goals of economic development are in conflict with those of environmental protection effectively undermines attempts to address environmental problems. Frequently cited arguments for inaction include:

- "Everybody grows first and cleans up later" – and this should apply to the NIS as it has elsewhere. What we need now are jobs and growth in order to generate the resources necessary to address environmental problems later.
- We cannot enforce the emission/discharge standards because we would have to close many factories and leave whole cities without means of livelihood.

- Individual incomes are low, so the prices of energy and water should be kept at affordable levels through subsidies.
- Public resources are very limited, and little money is left for addressing environmental problems after more important or urgent programs get financed.

10. Each of these arguments illustrates the difficult choices concerning the use of natural resources and the priorities for improving environmental quality in the context of the transition to a market economy. Environmental valuation provides a tool to advise decision-makers which interventions are most urgent and which can wait. It helps direct resources to those activities, which achieve environmental benefits or mitigate environmental damage at least cost.

11. Economic growth and creation of jobs is undoubtedly a first-order priority for the NIS. It is also true that some economies grew fast while heavily disrupting their natural environments. This was partly a result of ignorance of the damaging consequences for human health and for the livelihoods of those who depended on the use of natural resources, and partly a result of the lack of effective environmental regulations. With hindsight, however, it has been estimated that society in these countries ended up paying more in terms of damages and their remediation than it would have had to pay had environmental regulations been in place and implemented at the time of rapid growth (see Box 1).

Box 1: When should environmental expenditures be made?

Most industrialized countries have faced the need of large expenditures to remedy the effects of past environmental neglect. Their experiences suggest that it is very expensive to undertake a rapid transition from neglecting environmental goals to giving them high priority. Countries that wish to catch up with the environmental performance of OECD members will find it more effective and less expensive to undertake the transition over a long period – starting sooner, rather than later.

Recent analysis in Japan compared air pollution abatement costs to the cost of health damage cause by air pollution. The comparison took a rather conservative approach, in that the pollutant studied was sulfur dioxide, a substance less damaging to human health and more expensive to control than some other pollutants. Even so, the study concluded that Japan would have been better off had it taken action 5-10 years earlier than it did.

Source: World Bank (1997) "Can the Environment Wait? Priorities for East Asia." Washington DC

12. The NIS economies are at a stage of development where the greatest improvement in environmental performance is expected to result from improved management of scarce resources and technological modernization linked to new investments. If a proper environmental regulatory framework is in place at the beginning of the modernization effort, and if enforcement is credible, then environmental considerations will be incorporated into investment decisions and adverse environmental impacts, possibly entailing huge losses, will be prevented.

13. Enforcement of environmental regulations is often relaxed out of concern for social problems that might arise, especially in the case of one-company towns. Economic valuation can help determine whether environmental health damages are so large that allowing a polluting business to continue operation would result in increased spending on health care and unacceptable risks to public safety. Sometimes, however, the social cost of unemployment and the associated potential health damages from

under-nutrition are larger than the potential environmental damages associated with continued operation, and the enforcement authority needs to consider these effects¹.

14. Economic valuation can also help determine the environmental cost related to excessive natural resource use and the willingness of people to pay for environmental services. There have been only a few studies in the NIS on how much people are willing to pay for services such as sanitation, provision of potable water, electricity, etc. Local authorities tend to set prices for such services below their costs, and probably below what households would be willing to pay should they be asked about their preferences. Keeping these tariffs very low increases the demand above its socially justifiable level and puts excessive pressure on natural resources and public funds for the provision of these services.

15. It is certainly true that financial resources are severely limited and that expenditures for environmental improvements compete with other urgent development needs. Hence the need for prioritization and for a justification of environmental benefits based on their net benefits or their contribution to the well-being of the population. There is a risk of focusing only on restricted financial resources as the root problem and of postponing environmental improvements until a more prosperous future. A clear assessment of the value of environmental damages or benefits can help find solutions that can be implemented now without substantial financial resources, or in some cases can help save resources (see Box 2).

Box 2: Fighting infectious diseases in Orlovsky District, Rostov Oblast, Russia

The Orlovsky District Administration was concerned that the frequency of hospitalizations due to gastric-intestinal diseases in the district was far higher than the oblast average and the average in neighboring areas. Expansion of the infectious disease ward of the district was considered. Increasing the number of beds from 60 to 90 and installing additional equipment would have cost approximately US\$2.2 million.

However, analysis of the causes of increased incidence of infectious diseases showed that its main cause was the unsatisfactory quality of water abstracted from ground sources. A chlorinating station for water disinfection was built in 1999 for a cost of US\$ 220,000. In a few months, the frequency of cases of acute gastro-intestinal disorders drastically diminished, and there was no longer a need to expand hospital capacity.

Source: World Bank staff, North Caucasus Regional Policy Unit, Russia Environment Management Project

Economic Valuation of Environmental Impacts – Brief Overview

16. Governments, especially ministries of finance and economy, usually have much clearer perceptions of the costs associated with implementing environmental regulations than of the benefits of these measures or the costs of inaction. One reason for this is that assigning monetary value to these benefits and losses is not easy. Economists recognize that there are several components of value, some of which relate to using things and some to merely knowing that things exist. The former have been named "use values" and the latter "non-use" or "passive use" values (see Box 3).

¹ A technical example of such a decision is described in "Employment and environmental protection: the tradeoffs in an economy in transition," Anil Markandya, NIS-EEP Project, Environment Discussion Paper No. 26, HIID, August 1997.

Box 3: Categories of economic value

Economic analysts assume that for all practical purposes values are assigned in the process of consumption rather than production. In other words, nothing has a value unless it serves human need either directly or indirectly as a factor of production. The total economic value attributable to the use of the environment and natural resources may be obtained by summing estimates of value for each of the following five major categories:

- **Direct use entailing physical resource extraction.** Examples include consumption of goods provided by biological resources such as timber, fibers, food, medicinal herbs, fossil fuels and other mineral resources.
- **Direct use not entailing physical resource extraction.** Examples include consumption of services derived from natural resources, such as tourism, recreation, education and scientific research.
- **Indirect use.** Society benefits from ecological functions that support economic activity and human welfare, e.g. waste dissipation/assimilation, climatic functions and water retention provided by forests.
- **Optional use.** This category reflects known and hypothetical future uses of any type listed above. For example, preserving biodiversity may be viewed as holding an insurance policy against various courses of events and keeping society's options open.
- **Non-use (passive use) values.** These reflect satisfaction from the existence of a resource such as a mineral deposit, an organism, species or ecosystem, as well as from its bequest to future generations.

17. Environmental valuation involves placing monetary values on environmental goods and services and on changes in environmental quality resulting from certain actions or inaction. Unlike other goods and services, environmental ones are not subject to market transactions and their value is not revealed by market prices. However, economists have developed ways to estimate their value on the basis of physical or behavioral linkages between the indicators of environmental quality and the observed effects on health, productivity, or natural resource assets. **Physical linkage methods**, known also as dose-response methods, rely on a technical relationship between environmental degradation and physical damage, without taking into account the subjective preferences of the affected people. **Behavioral linkage methods** assume that the value of environmental goods and services can be approximated by people's willingness to pay for improved environmental quality or to escape deterioration. Behavioral linkage methods can be subdivided further depending on whether people's preferences are revealed indirectly, through market behavior, or directly, through a statement (see Boxes 4, 5, and 6).

18. A major difficulty in valuing environmental impacts arises because of so-called externalities, i.e. those outcomes – both intended and unintended – that affect third parties. They can be either positive (e.g., when a natural resource is conserved or reconstructed for a common good) or negative (e.g., when pollution is emitted). The problem with valuing externalities is that they are not subject to market transactions and, consequently, there are no market prices that can capture the economic values involved. The agents generating these external effects do not bear the full benefits/costs of their actions. Nevertheless these benefits and costs are "real" in the sense that they add/ subtract – perhaps indirectly – from someone's material resources or level of satisfaction.

19. The most frequently considered environmental externalities are those related to human health. Epidemiological studies have determined the health effects of certain harmful substances discharged into

air or water. The quantitative relationships linking pollutant concentrations to morbidity and mortality, called “dose-response functions,” are central to carrying out health risk assessments. To establish the health costs of pollution, researchers study patterns of exposure to the pollutant, costs of health care, work days lost due to illness, and, in the cases where the impact is increased mortality, the value of human life.

20. The costs associated with health externalities are sometimes so significant that costly preventive measures are economically justified. For example, the water-pollution related mortality and morbidity costs in Moldova were estimated at US\$ 60-115 million annually. Provision of piped water of adequate quality from different sources would cost US\$ 23-38 million annually. Thus, investments in improvement of drinking water would be well justified on the basis of potential savings in health costs.

Box 4: Valuing the health and safety effects of environmental degradation: physical linkage methods

Techniques that use a dose-response (damage) function relating pollution exposure to health and productivity changes include the **Cost-of-Illness** approach, the **Human-Capital** approach, the **Cost-of-Productivity-Loss** approach, and the **Replacement-Cost** approach.

Estimation of health and productivity effects requires three steps:

1. Risk assessment to determine a relation between indicators of environmental quality and human mortality/ morbidity rates, or productivity changes of bioresources, or material damages.
2. Calculation of physical damage for the specific situation, using the dose-response coefficients estimated in Step 1.
3. Evaluation of the monetary value of calculated damages using prevailing market prices for medical resource costs and statistical estimates of the value of life.

A frequent drawback of physical linkage analyses is the lack of scientific knowledge about causal relationships and lack of relevant data to establish one.

21. At the same time there are cases, where the perceptions of the costs of environmental damage are unrealistic. For example, a multi-media health risk analysis for Samara Oblast, carried out by Russian analysts, found very low carcinogenic risk associated with drinking water. This finding was contrary to local opinion that leakage from a technogenic oil bed located in the village of Lipyagi posed significant carcinogenic risk. The study results showed that air pollution abatement would be more likely to contribute to lower cancer rates².

22. In addition to human health, changes in environmental quality may also lead to changes in productivity or may affect the state of natural resource assets. For example, pollution of water bodies may lead to significant losses in the fishing and tourist industry. A careful consideration of these potential impacts may provide economic justification for measures to mitigate pollution.

² Application of risk assessment in Russia (Samara Oblast). International Institute for Health Risk Assessment. Moscow, 1999.

Box 5: Valuing non-market goods on the basis of stated preference: Contingent Valuation Method (CVM)

The CVM attempts to measure individual “willingness to pay” (WTP) for environmental improvements by directly questioning a representative sample of individuals. This method has universal applicability in valuing non-market environmental goods, including non-use values such as option and existence values, and has minimal requirements for secondary data. CVM studies are conducted using surveys whose design is important in interpreting the results. Standard survey-design quality-assurance procedures must be followed (such as use of control questions, piloting of the instrument, use of representative samples, interviewer training, etc.). CVM studies have received mixed assessments because of the potential discrepancy between stated behavior in a hypothetical situation and actual behavior. However, many researchers feel that conventional biases can be dealt with through better survey design or through careful interpretation and qualification of the final results.

23. Two central concepts in valuing externalities are the individual’s “willingness to pay” (WTP) for environmental improvements and the individual’s “willingness to accept compensation” (WTAC) for adverse changes in environmental quality. Estimating WTP has important applications in decisions about upgrading and rehabilitating environmental services infrastructure and in pricing the provision of such services.

Box 6: Determining the demand for environmental goods and services: revealed preference methods

Hedonic Pricing methods aim to measure the implicit value of environmental quality as revealed by individuals’ preferences for related market goods. Commonly used markets are the housing and labor markets. The assumption is that WTP for environmental quality and safety can be inferred from information on price and wage differentials on one hand and environmental risks or characteristics associated with a specific area or job, on the other. The data and econometric knowledge requirements for conducting a hedonic pricing study are quite burdensome, however. Moreover, in heavily regulated or otherwise distorted housing and labor market, the available market data will convey erroneous information.

Travel Cost methods are widely used to estimate the amenity and/or recreational value of outdoor recreational sites such as parks and lakes. The underlying assumption is that people’s demand for the recreational site is revealed through their willingness to spend money and time travelling to the site. Data on travel costs and other socio-economic characteristics of users is collected through site surveys and aggregated to produce the aggregate demand curve. This method is less applicable to urban amenities requiring only short trips.

The **Averting/Mitigating Behavior** approach studies the costs (monetary and opportunity) that people incur in order to avoid adverse environmental impacts. Expenditures are usually for substitute goods (e.g., buying bottled water instead of using tap water) or for activities reducing the associated environmental impacts (e.g., the cost of soil-erosion prevention). The underlying premise is that an individual’s perception of the cost imposed by adverse environment quality is at least as great as the individual’s expenditure on goods/activities to avoid the damage.

24. While productivity changes can be evaluated with relative ease by considering changes in prices of market goods, estimating the amenity and recreational value of natural resources (water bodies, national parks, species), on the other hand, tends to be a more complex task because it involves subjective values. There are a number of techniques for assessment of subjective values, and the information obtained in such studies can be especially useful in decisions about developments of forestry sector, agriculture, road infrastructure and the like, involving consideration of competing commercial and non-commercial uses.

25. Table 1 below summarizes the broad range of circumstances where assessment of the values of environmental impacts can provide useful information to decision-makers at national, municipal, and project level. It is important to bear in mind that environmental impacts are only part of project/policy outcomes, and therefore environmental valuation should be viewed as only one element in the process of decision-making, complementing engineering, financial, and economic analyses of proposed projects and policies. Ultimately, the decision-making process is political, and it is important that politicians be well informed about the potential consequences, both positive and negative, of their decisions.

Table 1: Suggested Applications of Environmental Valuation at Different Levels of Decision-making

	Priority Setting	Policy Design/Analysis	Investment Selection/Appraisal
National/ Regional Level	<ul style="list-style-type: none"> Federal budget allocation for environmental protection, public health and sustainable development; National and/or regional priority-setting to allocate scarce financial and human resources; Assessment of effects of policies related to natural resources (e.g., licensing, trade, and property rights). 	<ul style="list-style-type: none"> Setting environmental standards/fees/taxes; Support for regulatory actions and legislation through estimation of environmental benefits and losses which would be incurred by inaction, late adoption or elimination of laws/regulations 	<ul style="list-style-type: none"> Appraisal of large-scale public investment projects which have major impacts on environment and natural resources; Environmental impact assessments and state environmental reviews.
Municipal Level	<ul style="list-style-type: none"> Municipal budget/local environmental fund allocation; Negotiation with the region for money from a regional budget for environmental protection. 		<ul style="list-style-type: none"> Verification of environmental effects for projects receiving concessionary finance from municipal environmental funds; Negotiation of intermediate compliance targets for large polluters; Land use planning and development; Insurance against environmental risks.

III. RECENT PRACTICES IN USING ENVIRONMENTAL VALUATION IN DECISION-MAKING IN THE NIS

26. The idea that environmental impacts of proposed investments have to be accounted is not entirely new to the NIS. In 1987, the State Committee for Environmental Protection of the former USSR adopted guidelines for calculating the cost of adverse environmental impacts. The so-called “Metodika”³ has limitations in its ability to capture true value. It was used primarily for assessment of environmental fees to be paid by polluting enterprises. Valuation of environmental impacts was not used for priority setting or regulatory decision-making at the national level. In recent years, however, modern methods have been applied to evaluate environmental impacts (both positive and negative) at the project level and

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USSR State Planning Committee, USSR State Committee for Science and Technology, USSR State Price Setting Committee and the USSR Academy of Sciences “General Rules for Damage Calculation and Cost-benefit Analysis of Abatement Measures.” Moscow, 1986.

to support regional and national priority setting. This chapter will provide illustrations of recent experience and will discuss the technical and institutional constraints on applying modern methodologies for valuation in the NIS countries.

The NIS “Metodika” for damage estimation: description and limitations

27. The main idea of the “Metodika” was to aggregate different pollutants into standard units and to assign economic value to a unit of aggregate pollution. The national guidelines (1987) used specified conversion coefficients to convert metric tons of emissions/discharges into “standard” tons of emissions/discharges. These conversion coefficients were based on epidemiological data on the relative harm caused by pollutants, emission source location, height of pipe, speed of emissions and climatic conditions. The system proved to be too complicated for implementation, so it was simplified, and in the

Box 7: Comparison of estimates of environmental damage costs

As part of the analytical work to define priority environmental actions in the Regional Environmental Action Plan for Sverdlovsk Oblast, a team of Russian and international specialists attempted to assess the cost of environmental damages from pollution. For air pollution, estimates were generated in two ways: (i) using the current Russian methodology of damage estimation, and (ii) using the OECD-recommended methodology based on dose-response functions. Below are the results for three major pollutants:

Table: Rate of Health Damage from Pollutant Emissions into Ambient Air

Damage (thousands of dollars/ton)	OECD method	Metodika
Particulates	5	0.2
Lead	123	13
SO₂	0.2	0.1

The team concluded that the Russian methodology consistently undervalued the costs of environmental damages. The discrepancy was probably overstated, because the value of loss of life used in the estimation process (\$0.35 mln), based on OECD estimates, was considered high by Russian experts. Even so, the team was unanimous in finding that the Metodika calculations underestimated environmental damages in the oblast, leading to a lower-than-optimal level of investment in pollution abatement.

Source: Ural Regional Environmental Action Plan, produced as part of technical assistance under World Bank

process its scientific basis was eliminated.

28. The most controversial step was the valuation of a “standard” unit of aggregated pollution. For air pollution, the value was RUR 2.6 per “standard” ton, for water pollution about RUR 400 per “standard” ton. There was an initial attempt to base these values on the economic value of human life and human health, damage to agriculture, the forest sector, fishing, or productive assets, and so on. But, for all practical purposes, the values were assessed with a view to raising the necessary resources for mitigating actions. In other words the valuation reflected planned “willingness to pay” for pollution reduction instead of real economic damage from this pollution.

29. This method tends to underestimate the costs of environmental damages. For example, estimates of the costs of air pollution damage in Sverdlovsk Oblast based on dose-response methodology appear to be an order of magnitude higher than the estimates produced using the “Metodika” (see Box 7). Another major shortcoming of the “Metodika” is the lack of consideration of exposure data, which means that the damage costs associated with a ton of particulate matter emitted by a factory would be the same for a factory situated in the middle of a major city and for a factory situated in less densely populated areas.

Applications of modern methodologies in the NIS

30. In the past 10 years, valuation studies have been carried out in the NIS (primarily Russia), mostly in the context of capacity building efforts such as development of national and regional strategies or enhancement of technical skills. These studies were usually supported, both financially and intellectually, by international experts and institutions. Annex 1 describes the methods used and results obtained in studies reviewed for this report. Some studies (e.g. the study of Severstal Iron and Steel Works in Cherepovets) have been conducted in cooperation with decision-makers and their results have been incorporated into investment decisions. Other studies have been met with skepticism or open resistance from authorities (e.g., surveys of Moscow drinking water). The main lessons learned from the limited experience gained so far with valuation studies in the NIS has been the importance of careful interpretation of the results and the need to improve communication between technical experts and decision-makers.

Box 8: Using valuation for environmental priority setting at the national level – the Moldova NEAP

The health impacts of water and air pollution were quantified. Polluted drinking water emerged as the major environmental health problem in Moldova. Estimated average annual costs resulting from water pollution were US\$ 60-115 million due to premature deaths and US\$ 6-12 million due to illness. The health benefits of supplying piped water of adequate quality from alternative sources were approximately 3 times larger than the average investment costs.

Premature death and illness associated with exposure to air pollution (TSP, SO₂, Pb) were estimated to cost the economy US\$18-33 million, of which US\$ 17-30 million was attributable to particulates and US\$ 1.5-3 million attributable to lead. Productivity losses of agricultural land erosion were estimated to cost US\$ 45-55 million annually.

Source: National Environmental Action Plan, World Bank and Government of Moldova (1995).

31. In 1995, the World Bank and the Government of the Republic of Moldova prepared a National Environmental Action Plan that used environmental valuation to set national priorities. Estimates of the costs of health and productivity impacts formed the basis for both institutional and sectoral recommendations. A large share of health costs appeared to be due to unsafe drinking water (see Box 8).

32. Most NIS studies attempt to evaluate the health costs of air pollution in major urban centers. The dose-response functions linking air pollutant concentrations to mortality and morbidity are well developed in OECD countries, as are standard procedures for adjustment of these functions to different contexts. Since people can take only limited measures to avoid polluted air (i.e., people who live and/or work in a particular area must breathe the air there), exposure can be determined with reasonable certainty and health costs can be estimated relatively quickly.

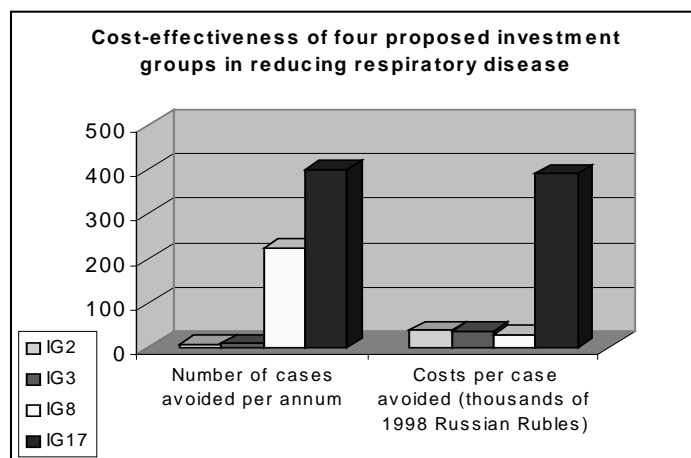
33. Studies have consistently found air pollution to be a serious health risk. In the case of Sverdlovsk Oblast, Russia, annual costs were estimated at up to US\$1.1 billion, about 13% of the oblast GDP in 1996⁴. Another study, conducted by HIID in Volgograd, found that net benefits in terms of health improvements proposed particulate control measures would be about US\$ 40 million. Indeed, the cost per life saved of the measures suggested for Volgograd would be only US\$ 90 – 200⁵.

34. A comprehensive air pollution health risk assessment was carried out for the Severstal Iron and Steel Works in Cherepovets (Vologda Oblast, Russia) by Russian experts working with public health experts from Harvard University. The results of the study were incorporated into cost-effectiveness analyses for 19 investment projects proposed under the Federal Program for Environmental and Population Health Remediation in Cherepovets (see Box 9).

Box 9: Using valuation for prioritizing investment at the plant level – Severstal Iron and Steel Works

The study was part of a technical assistance program financed by a World Bank loan to the Government of Russia under the Environmental Management Project. The objective was to advise the plant and municipal authorities on optimal investments under the Federal Program for Environment and Population Health Remediation. A joint team of Russian and international consultants assessed the potential reduction of health risks to the population of the city of Cherepovets associated with each of 18 proposed groups of investments. Using this data, together with data on the cost of each investment group, it was possible to rank the investment groups in terms of their cost-effectiveness in reducing mortality, respiratory and cardio-vascular disease.

The graph below summarizes the findings for respiratory disease. Investment group 17 is the most effective in reducing the number of cases, but is not necessarily the most cost-effective. The team's recommendation to Severstal management and the Cherepovets authorities was that a combination of investment groups 2, 3 and 8 would achieve significant health benefits at lowest cost per life saved/disease avoided.



Investment Groups:

IG2: Improve operation of coke dry-quenching unit #2 to eliminate release of coke gas

IG3: Improve operation of coke dry-quenching unit #3 to eliminate release of coke gas

IG8: Improve refractory lining and provide gas/waterproof hatches for coke oven batteries

⁴ Center for Preparation and Implementation of International Projects on Technical Assistance: Urals Regional Environmental Action Plan: Executive Summary. Ekaterinburg, 1998; p. 19.

⁵ Larson, Bruce A. et. al. "The Economics of Air Pollution Health Risks in Russia: A Case Study of Volgograd," Environment Discussion Paper No. 38, NIS-EEP Project, HIID, January 1998.

IG17: Aggregate gas by-products recovery and treatment in selected units

Source: *World Bank Russia Environment Management Project. "Economic analysis of industrial pollution abatement investments in Severstal Iron and Steel Works in Cherepovets, Executive Summary. Moscow, 1999*

Constraints to a wider use of economic valuation of environmental impacts in the NIS

35. The constraints on a wider application of environmental valuation in the NIS are both technical and institutional. Technical constraints, e.g., data availability, data quality, price distortions, etc., impose limitations on the results and influence how the results should be interpreted. They can in many cases be overcome by careful design and execution of the study. Institutional constraints, on the other hand, make implementation of the valuation studies more difficult or limit the use of the results in the decision-making process. Some of the constraints discussed below are not exclusive to the NIS, so a sizeable body of research already exists on how to deal with them. However, some apply to an NIS setting to a critical degree, and may impair the quality and accuracy of results more seriously than they would in developed market economies.

36. *Information gaps* present an important challenge since many of the cause-effect links between environmental problems and outcomes (e.g. the link between water or air pollution and health effects) are only partially understood or measured. If data on levels of air and water pollution, numbers of people exposed, and incidence of disease or premature death are not available, it is difficult to apply the traditional dose-response approach to valuing changes in health outcomes due to changes in pollution levels. The required data can be collected, but this is a time-consuming and often expensive endeavor. There are ways to transfer estimates of dose-response relationships from other locations to produce rough but quick estimates of pollutant impacts – these are useful only if relatively large margins of error are acceptable.

37. In the NIS, both the existence and the reliability of data present problems. The data necessary for health risk assessment is fragmented, because agencies responsible for monitoring different indicators are under the jurisdiction of environment, public health, or public utility authorities and incentives to link databases are low. Some key pollutants are not monitored or, if they are, the measurement techniques are outmoded. For example:

- Information on total suspended particulates (TSP) is of limited use because it is not known what fraction of particles are smaller than 10 or 2.5 microns (PM_{10} or $PM_{2.5}$), the particle size that causes most health damage. There are no monitoring data of 24-hour or 1-hour concentrations of sulfur dioxide, so analyzing acute effects of exposure to high concentrations of sulfur dioxide is not possible, even though brief exposures to high concentrations are more likely to cause health damage than long-term exposures to low “annual average” concentrations.
- There is no systematic monitoring of water at the tap. Yet, much contamination occurs in the distribution network after water leaves the treatment plant, and without data on tap water quality there is little way of estimating actual exposures.

38. A second information constraint is related to the low *public awareness* of the types of natural resources at risk from degradation, and of the potential negative impacts of air and water pollution on health and natural resources. This is important, because many valuation measures are based on willingness-to pay (WTP) surveys (not necessarily just on direct measures of health or productivity outcomes) and such measures are more accurate when the population is knowledgeable about the

situation. Public information is very important in this case, especially understanding of the cause-effect links, and of the nature of threats.

39. Linked to information and knowledge is another major factor: the *income levels* of the population. Willingness-to-pay is clearly linked to ability-to-pay, and this in turn is largely determined by income levels. Poorer people have fewer options and are naturally less willing to sacrifice some immediate income in exchange for longer-term benefits to health or sustainable ecosystems. It is important to recognize that WTP is captured at a specific moment of time and may change with circumstances. As incomes grow, both demand and willingness-to-pay for environmental improvements will grow. Hence it is critical to prevent irreversible changes, such as species extinction, when incomes are low.

40. On the institutional side, the major constraints include the lack of capacity and resources to carry out the studies, lack of transparency in investment decisions, and decision-makers' perceptions that the uncertainties involved in the estimation process render the results too arbitrary to serve as grounds for decision-making. These constraints can be overcome by adopting a set of standard guidelines on the use of environmental valuation in net benefit analysis and by developing local capacity for undertaking valuation studies. Some preliminary guidelines were developed at the training workshop in Moscow and a small task force was formed to elaborate them and present them in a form appropriate for adoption (see Box 10).

Box 10: Guidelines for economic valuation studies:

1. *Start the analysis simply, with the most easily valued environmental impacts.* Any analysis will quickly become complicated, so it is important to focus on the major environmental issues, and especially those where valuation is most feasible. This often means a focus on production or health impacts. In other situations it may be loss of recreational benefits.
2. *Recognize the symmetry between benefits and costs.* In the case of air or water pollution, health costs avoided (including costs of treatment, drugs, and lost work-days) are an important measure of the benefits from pollution reduction.
3. *Always carry out the analysis in a with-intervention and without-intervention framework.* The correct comparison is not between now and some time in the future, but rather between what would be the situation with the intervention, versus what would be the situation without the intervention. In some cases conditions may worsen over time, even with the proposed intervention, but would have become even worse had no action been taken.
4. *State all assumptions explicitly, and identify data used and any additional data needs.* Others can assess the analysis and results only if they clearly understand the assumptions and data used. Such understanding will allow replication of the analysis using alternative assumptions and/or data.
5. *Finally, valuation studies should be well documented and should pass peer review.* This step helps ensure that the results are credible and can be used for policy analysis.

IV. APPLICATIONS OF ENVIRONMENTAL VALUATION IN DECISIONS CONCERNING WATER POLLUTION CONTROL AND URBAN WATER SUPPLY

41. A number of complex decisions at the national and local levels influence the quality of water resources and the safety of drinking water delivered to residents. Valuation of environmental impacts can be used to assess the efficiency of proposed or enacted regulations, to calculate the net present value of

proposed investments in water infrastructure, or to estimate the willingness to pay for municipal water services. This section will relate experience from the United States, United Kingdom, and Eastern Europe to illustrate the potential role of environmental valuation in regulatory and investment decisions related to water supply. It will also discuss the limited NIS experience in estimating willingness to pay for water quality improvements.

Box 11: Regulatory Impact Analysis of Lead in Drinking Water

Levels of lead in household drink water depend on (a) concentrations of lead in water as it leaves the treatment plant, (b) the extent of lead pipes, fittings or solder in the water distribution system, and (c) the corrosivity of water, which affects the amount of lead that leaches out of pipes and solder. Setting an MCL for lead, which applies only to water as it leaves the treatment plant, cannot guarantee a maximum level of contamination in the home. USEPA therefore directed water companies to sample water in private homes and to reduce the corrosivity of water if lead concentrations in home samples exceeded a certain threshold. The RIA quantified the costs and benefits of alternate threshold concentrations.

USEPA's 1991 RIA for lead in drinking water focused on the health benefits of reducing lead. These included reduced hypertension, coronary heart disease and premature death in prime-aged men, and fewer instances of lead poisoning and IQ loss in children. Dose-response functions were used to quantify changes in these health endpoints. Heart attacks and premature deaths avoided were valued at US\$1 million and US\$2.5 million (1988 US\$) per case. Avoided medical and compensatory education costs were used to value reduced lead poisonings in children, and changes in earnings were used to value IQ gains from reduced lead exposure. Other benefits that were quantified but not monetized included reduced damage to pipes and plumbing from reducing water corrosivity.

EPA evaluated benefit-cost ratios for alternative threshold levels of lead in household drinking water and chose an alternative which would almost certainly yield a benefit-cost ratio greater than 10. By showing positive net benefits from the rule, helped gain political support for it

Source: US EPA. Regulatory Impact Analysis of Lead in Drinking Water. Washington DC, 1991.

Benefit cost analysis of drinking water quality and effluent discharge standards in the US

42. Beginning with Ronald Reagan, all U.S. presidents have issued Executive Orders that require Regulatory Impact Analyses (RIAs) of regulations costing US\$100 million or more annually.⁶ As a result, benefit-cost analyses have been conducted for all major environmental regulations issued since 1981. The *use* of these benefit-cost analyses in setting environmental standards is limited by the laws under which the United States Environmental Protection Agency (USEPA) operates⁷. Nonetheless, the benefit-cost analyses that have been conducted show how regulations *could have been improved* had the USEPA been able to use the benefit-cost analyses in setting standards.

43. *Benefit-Cost Analyses of Drinking Water Standards Under the Safe Drinking Water Act.* Until passage of the 1996 Safe Drinking Water Act, USEPA was to set maximum contaminant levels as close to health-based goals as feasible. In determining whether health-based goals were feasible, the USEPA

⁶ Reagan's Executive Order 12291 may be found in 46 *Federal Register* 13193.

⁷ The National Ambient Air Quality Standards, for example, must be set to protect human health without regard to cost. The statutes that allow benefits and costs to be weighed in setting environmental standards include the Toxic Substances Control Act (TSCA), which regulates toxic substances (such as asbestos) in consumption and production, the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), which regulates pesticides, and the 1996 Safe Drinking Water Act.

could consider compliance costs, but formal benefit-cost analysis was not allowed. The 1996 Safe Drinking Water Act changed this guidance, allowing USEPA to compare the benefits of a proposed standard with its costs. A Regulatory Impact Analysis, was conducted for lead in drinking water. The analysis was useful in helping the agency choose among alternate standards, and demonstrates the type of information that a good benefit-cost analysis can provide (see Box 11).

44. The fact that US law has discouraged use of benefit-cost analyses as a basis for setting drinking water standards should not deter other countries from using such studies to improve the efficiency of environmental regulation. For the NIS, regulatory impact analysis can be helpful in setting interim target standards and in determining whether the compliance costs associated with a particular standard are commensurate with the benefits that it is intended to achieve.

Regulatory Impact Assessment of proposed water quality regulations in the United Kingdom

45. The UK government was one of the first in Europe to give special consideration to the cost-effectiveness of pollution abatement technologies. The Environmental Protection Act of 1991 requires regulators to consider not just the technical feasibility of mandated technologies but also their cost-effectiveness in achieving water quality targets. Specifically, the Act modifies the Best Available Techniques (BAT) principle to Best Available Techniques Not Entailing Excessive Costs (BATNEEC), permitting regulators to relax the BAT requirement if the additional reduction of effluent associated with BAT is not substantial enough to justify very high compliance costs.

46. EU environmental directives set water quality standards that member countries are obliged to achieve by a specified date. Member governments have discretion on the specific implementation arrangements. Recently, the U.K. government proposed a set of new regulations necessary to ensure compliance with the EU Directive on the Quality of Water Intended for Human Consumption (98/83/EC). The Regulatory Impact Assessment for the set of regulations found that the value of expected benefits would be at least GBP 850 million would outweigh the expected cost of the regulations: GBP 490 million for investments (over the period 2000-2005) and GBP 22 million in annual recurring costs. In addition, the analysis demonstrated that the new regulations would not impose a large burden on household users because the expected improvements in efficiency of the water companies would offset part of the charge increases under the proposed regulations⁸.

47. Although the UK, as a member of the EU, does not have any realistic option but to implement the Directive as it is European Law, this example shows that Regulatory Impact Assessments are an essential part of the public consultation process and can alert sectoral departments and local governments about specific industries and/or areas that might bear a disproportionate burden of compliance costs. For the larger countries among the NIS, where regional authorities have discretion in implementing centrally set standards, such analyses can help direct the enforcement effort to regulations where the benefits are relatively large in comparison to the compliance costs.

⁸ UK Department of Environment, Transport and the Regions (2000). The Water Supply (Water Quality) (England) Regulations 2000. Consultations on Regulations. Crown. Available on the internet at <http://www.environment.detr.gov.uk/ras/index/htm>

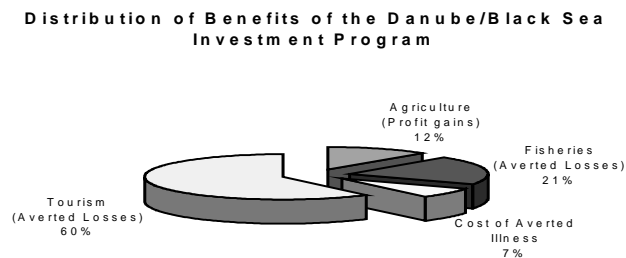
Box 12: Benefit Cost Analysis of a proposed investment program for nutrient reduction in the Danube River and the Black Sea

The degradation of the Black Sea, caused largely by heavy nutrient inflow from point and non-point land-based sources, has had significant economic consequences for the littoral countries. A region-wide initiative to promote recovery of the Black Sea produced the Danube River and Black Sea Strategic Action Plan. The overall plan calls for a series of urgent investments in nutrient-removal initiatives, including industrial and municipal wastewater treatment, wetlands restoration and promotion of environmentally-friendly agricultural practices (conservation tillage, animal waste systems, etc.). The program is to be implemented over a period of 20 years.

Under a baseline investment scenario (US\$40 million), projected nutrient loads for the next ten years show an upward trend which would lead to significant losses in the fisheries and tourism industries along the Danube River and the Black Sea coast and would impose additional health costs on the population. Under the strategic investment program, nutrient loads are projected to decline, preventing those losses and contributing added benefits to the agriculture sector.

The benefits of the strategic investment program were estimated on the basis of averted productivity losses in the fisheries and tourism industries, cost of averted illness, and productivity gains in the agriculture sector. As shown by the graph, the bulk of benefits of nutrient removal would accrue to the tourism and fisheries sectors, while health improvements play a less significant part. On the cost side, an important item is the O&M costs of the wastewater treatment facilities. The net benefit of the strategic program was estimated at US\$216-726 million, and the benefit-cost ratio at between 1.23 and 1.76.

The benefit cost study provided guidance to the World Bank and GEF in the design of a strategic partnership program of investments (US\$300 million) intended to catalyze domestic and donor finance to achieve the full investment program identified under the Strategic Action Plan.



Source: "Strategic Partnership for Nutrient Reduction in the Danube River Basin and the Black Sea: Cost-Benefit Analysis," Tijen Arin, Draft report, World Bank, ECSSD, 2000.

Environmental Benefits from Water Infrastructure Investments

48. The challenge for NIS is to develop a water infrastructure rehabilitation and upgrading strategy that can be implemented under severe financial constraints. Costly investments in building or upgrading wastewater treatment facilities are often proposed for the sake of improving environmental quality. Thus, the value of environmental benefits becomes an essential part of the net present value analysis of proposed projects and could have a significant impact on the final decisions.

49. In general, investments in facilities with high removal capabilities tend to be expensive and to entail high O&M costs. At the same time, engineering studies undertaken in Central and Eastern Europe have shown that significant improvements in pollutant removal can be achieved by modest upgrades, e.g. upgrading primary treatment plants by adding chemical treatment⁹. Additional degrees of pollutant removal, especially nitrogen removal, have higher and rapidly increasing marginal costs. Since health benefits depend on the residual pollutant in the water, most health benefits accrue as a result of primary or primary-and-biological treatment. Thus, the additional health benefits resulting from upgrading to secondary and tertiary treatment might not be large enough to justify the high costs.

50. However, amenity and recreational values are in some cases significant, and even more importantly, productivity changes which result from the investment need to be factored in (e.g., benefits to fishing, agriculture, tourism). The need for a treatment facility and the cost-effectiveness of alternative pollutant-removal technologies both depend strongly on the specific characteristics of the receiving waters and the use of the water source. When there is a severe threat of eutrophication, as is the case in the Black Sea, the potential ecosystem and productivity losses of inaction may be high, rendering the net present value of costly investments positive (see Box 12).

51. Having cleaner water sources, however, addresses only one cause of poor drinking water. Another pressing issue, especially in the NIS, is cross-contamination: infiltration of sewage water into drinking water pipes. One possible solution involves infrastructure upgrades; another - alternative water distribution arrangements (bottled water, water galleries, etc.). There has not been a comparative study of the cost-effectiveness of these approaches. Economic valuation of the health impacts could be very helpful in defining realistic investment and/or mitigation strategies for the short and medium term. One of the pilot studies described in the next section of the paper is expected to provide insights into this issue.

Determining Willingness-To-Pay for improvements in municipal water supply

52. Quantifying risks to human health from exposure to contaminated drinking water is more difficult. In part, this is because there are many different chemical and microbial substances that can contaminate water and damage health, many of which cannot be identified. In part, it is because exposure to contaminants varies greatly, depending on a consumer's position in the distribution network (houses far from the treatment plant are more likely to receive contaminated water than those that are closer), and on individual choices to boil, settle, filter or chemically treat water at home, or to drink bottled water.

53. CEE researchers and policy makers have often adopted modern valuation methods to estimate the value of environmental improvements. A review of USAID-sponsored valuation studies in CEE¹⁰ reveals that the whole range of available approaches has been applied and, in several cases, multiple approaches have been used to study WTP for improvements in municipal water services.

54. The Contingent Valuation Method (CVM) seems to be the most widely applied. Part of the reason for this could be CVM's relatively low requirements for secondary data, together with the existence in the region of fairly good and reasonably-priced capacity for survey design and

⁹ Somlyódy, Laszlo and Peter Shanahan, "Municipal Wastewater treatment in Central and Eastern Europe: Present Situation and Cost-Effective Development Strategies." The World Bank, Washington DC, 1998.

¹⁰ Morris, Glenn et al, "Valuation Studies in Central and Eastern Europe: A Stocktaking exercise" Draft April 2000.

administration. Some shortcomings of the CVM method associated with its use in the transition economy context have been identified in CEE applications, but they can be mitigated by careful study design and experienced oversight in the implementation.

55. Morris et. al. (2000) found few instances in which the results of the studies reviewed were introduced into the policymaking process in the CEE. The authors believe that this is due in part to the lack of formal requirements for incorporating environmental cost and benefits into the decision making process, and in part to the authors' failure to design the studies for maximum impact on policy making. The Iasi, Romania study demonstrated how early co-ordination with the policy "players" can enhance use of the study results in policy formulation (see Box 13).

Box13: Contingent valuation of municipal services in Iasi, Romania

The City of Iasi (400,000 inhabitants) is in northeastern Romania, not too far from the Moldova border. It is one of the biggest cities in Romania, the site of important heavy industry, power generation, oil extraction and refineries, chemical plants, pulp and paper mills, and timber and wooden product enterprises.

The study examined provision to households of cold water, hot water (including space heat from hot water systems), and municipal solid waste collection. The key valuation method used in the study was the contingent valuation of selected improvements in municipal services as expressed during a personal interview with a household member(s). The WTP estimates were combined with the engineering estimates of the average cost of achieving the service improvements described in the questionnaire.

The study provided a series of recommendations based on the results of the survey. In general, households would be willing to pay more for improved hot water service and improved metering than such service was expected to cost. The WTP for better solid waste collection was roughly equal to its anticipated cost, while the WTP for improved cold water services was less than the anticipated costs. Econometric models revealed that households' willingness to pay for improved cold water service would increase as the economy recovers and incomes pick up. These results were pooled with other observations into a list of recommended changes in price, service levels, and institutional arrangements for municipal services.

The results of the survey provided analytical support for policy makers to adopt new legislation introducing full cost water pricing policy, the beneficiary pays principle, and economic incentives for rational water use. The national water resources management strategy of the Ministry of Water, Forest and Environmental Protection and the new Water Law No.107/1996 took into consideration all the policy recommendations highlighted by the research. Full-cost pricing is an essential condition for the financial autonomy of local water utilities and consequently for the process of local decentralization.

Source: Morris, Glenn et al. "Valuation Studies in Central and Eastern Europe: A Stocktaking exercise" Draft April 2000.

56. In the NIS, a deep-rooted expectation that public services should be provided free of charge as in the past influences the results of willingness-to-pay studies. For example, CVM studies tend to indicate very low WTP for improved drinking water quality. At the same time, parallel estimates based on averting expenditures show a much higher WTP to avoid health risks of drinking water, e.g. by buying bottled water. A study, conducted in Danilovo (Yaroslavl Oblast, Russia) estimated WTP for improved tap water as US\$0.02 m³ based on CVM, and US\$7 m³ based on averting expenditure¹¹. This can partly be explained by attitude inertia from the past when municipal services were publicly provided at nominal or no charge, and partly by the unreliability of the tap water supply, a factor that would clearly reduce the ability to enjoy the cleaner water. Another study, in Chudovo (Novgorod Oblast, Russia) produced similar

¹¹ Cadastr NGO, Russia (1996). "Environmental Valuation of Natural Resources in Yaroslavl Oblast"

results, but the difference was smaller (US\$0.08 m³ using CVM; US\$5 m³ using averting expenditure method), leading analysts to believe that CVM studies produce better results when public awareness of the cost of providing services is higher and generally, in areas where people have greater experience with market transactions¹².

57. In sum, CVM studies of WTP for water services are a quick tool with low or no requirement for secondary data which is a major advantage in the NIS. Shortcomings in the method can be mitigated by careful design of the survey instrument, especially by educating the respondents about the situation through the questions (as shown in the Romania case study). Yet, it is advisable to verify results obtained through the CVM by other methods, and to bear in mind that estimates of WTP for public services produced by CVM tend to be lower than WTP estimates obtained by other methods.

Box 14 : Clean Water Program in the city of Rostov-on-Don, Russia

The Clean Water Program, implemented under the Mayor's decree is comprised of several measures. The first is construction of a "cold water gallery" in each of the city's eight districts. Five have been completed. The galleries, operating under a public-private partnership, provide 5 liters of water free to everyone who brings his or her own container, and sell quantities in excess this amount for 1 ruble a liter, about ¼ the market price of bottled water. People with incomes below the poverty line pay just 50 kopecks a liter for this water through a program operated by the city's social protection services.

A further measure is installation of filters at schools and hospitals to protect vulnerable people from exposure to contaminated water. The city is also promoting the use of filters in restaurants, cafés, owners of apartment buildings and households. It has established an exhibit of water filters, displaying a wide range of filters intended for different uses and ranging in price from RUR 200 to RUR 200,000. In addition, the program has undertaken a media campaign to raise awareness of the benefits of water filters.

At RUR 300 million, the clean water program presents a quicker and more cost-effective way to supply clean water to the city's residents than investment in piped water infrastructure which would cost approximately RUR 12 billion. These numbers need to be verified, but it is certainly true that such an effort is quite inexpensive and generates immediate results. Additional measures, not directly intended to improve water quality but rather to improve the operational performance and financial sustainability of the water utility, must also be considered, such as installation of water meters and improvement of billing and tariff collection. These will contribute to improved water quality in the long term by reducing excessive demand on the capacity of the water treatment plant and generating resources for investments in upgrading the water distribution system.

V. PILOT STUDIES UNDER EAP TASK FORCE PROGRAM

58. In order to demonstrate the potential use of environmental valuation for decision-making in the context of the NIS, the World Bank, as a partner in the Task Force for implementation of the EAP and with support from the Governments of the Netherlands and Finland, is currently conducting two pilot valuation studies, one in Rostov-on-Don, Russia and the other in Astana, Kazakhstan. The objectives of these pilots are two: (i) to provide relevant input to decision making and strategy formulation, concerning urban environmental management in the case of Rostov and water resources management in the case of Astana; and (ii) to build local capacity for environmental economic analysis and provide a relevant learning experience for the NIS-wide initiative on economic valuation of environmental impacts.

¹² Center of Environmental Economics and Natural Resources in Russia (1997). "Contingent Valuation of Drinking Water in Chudovo, Novgorod Oblast"

59. The study in Rostov will provide an updated assessment of the health burden caused by air pollution and unsafe drinking water. It will build on and refine estimates made in an earlier study produced for the Greater Rostov Area Strategic Environment Action Plan in 1994. It will also examine possible preventive and mitigating actions, assess their cost-effectiveness and advise local authorities of the findings.

60. Although at the time of writing of this report the study is still in progress, some interesting results regarding drinking water have emerged. The city planning department has initiated the "Clean Water Program" (see Box 14), which appears to be far more cost-effective in reducing health risks than retrofitting of piped water infrastructure. If confirmed, this result would suggest that the most cost-effective solutions to problems of drinking water quality in the short term may be measures to reduce exposure to contaminants (through the use of defensive measures such as bottled water or clean water from water galleries, filters, boiling and settling), rather than immediate measures to improve water quality in the system.

61. The Astana pilot study will identify and quantify the potential environmental benefits of alternative interventions for improving the water supply in the new Kazakh capital. (see Box 15) As relevant health and epidemiological data are not available to assess health costs by dose-response methods, CVM will be used. The study will be one of the first attempts to estimate amenity and recreational values as well as non-use values of biodiversity preservation. The results would inform decisions on the long-term water resources strategy for the city.

62. Though the impact of these two pilot studies on decision-making is yet to be seen, an important implementation lesson has already been clearly demonstrated: support for such efforts on the part of the decision-makers and constant communication between technical experts and regional development institutions are essential. Involvement of decision-makers contributes to better study design through clear specification of the problems at hand, and gives the study a practical, decision-oriented focus as opposed to an academic one. Other lessons have been suggested as well: The quality of the study will likely be enhanced by improved access to data from various institutions; and, finally, the understanding of the issues that decision-makers will develop as a result of interactions with study team will help them more effectively use study results in their decision-making.

63. Participants in the training workshop in Moscow developed concepts for valuation studies addressing problems relevant to their countries and/or pending decisions at hand. Annex 2 describes some of the proposed pilots, presenting further opportunities for application of modern valuation methods in the context of the NIS.

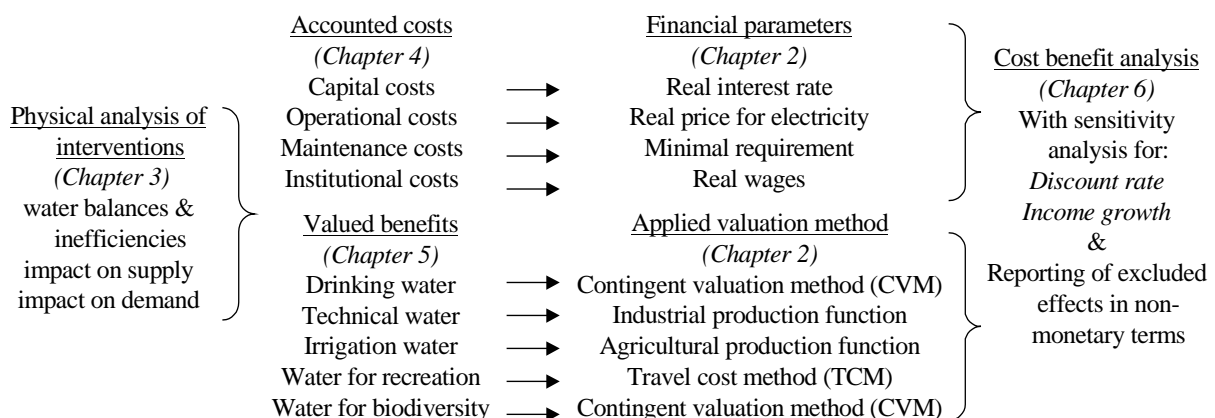
**Box 15: An Assessment of the environmental benefits of alternative water supply interventions
– a pilot study in Astana, Kazakhstan**

Background: Some 1.5 million people live in the Nura-Ishim river basin. Most of them live in Astana, the national capital. This newly created capital city is expected to double its population in the next 10 years, from about 275,000 to about 550,000. The water resources of the Ishim River will not be sufficient to meet Astana's increased demand in the medium term. The Nura River is linked by canal to the Ishim at Astana, but is not currently used due to the mercury pollution from the carbide factory in Temirtau (now closed down). The Government's options are: (a) bring additional water by constructing an extension to the Irtysh-Karaganda canal or (b) clean up the mercury from the Nura river. A further consideration is that the Nura eventually discharges into the Kuragaldzino wetlands, an internationally recognized nature reserve.

Objective of the study: The principal objective for the policy interventions analyzed is to provide a steady and safe supply of drinking water of sufficient quantity and quality to the growing population of Astana. The pilot study will focus on three potential interventions, considering both the demand and the supply side:

- Clean up the mercury in the Nura River. This would provide an abundant reliable source of water to the capital city of Astana, would provide more water for irrigation (150,000 subsistence farmers live along the river), would yield benefits to an internationally recognized water reservoir with rare birds, and might increase revenue from fishing.
- Bring in water by extension of the Irtysh-Karaganda canal. This alternative would involve rehabilitation of the entire canal (entailing high O&M costs) but could result in benefits for irrigated agriculture along the canal.
- Undertake policy and institutional reform encouraging water conservation by modifying tariffs and closing leaks, etc. The argument for the need for improved incentives and enforcement could be reinforced by the monetary value of benefits.

The general framework of the cost-benefit analysis is outlined below:



VI. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

64. NIS governments face difficult choices in allocating their limited resources to improve welfare, attain economic growth and reduce poverty. Environmental conditions can greatly influence the welfare of people, in particular their health and the sustainability of economic growth. However, the value of environment for society is often underestimated, because it is not easy to express in monetary terms. By contrast, the cost of investments to improve environmental quality is more easily measured and dominates the considerations of decision-makers. As a result, fewer resources are being allocated to improve environmental quality than would be optimal, and the cost of inaction is being ignored.

65. Economic valuation can help decision-makers to better understand the value of environmental improvements and of the damages that result from inaction. For that reason, economic valuation has become a well-developed field of economic analysis, and although there are special issues in the NIS transition economies, the basic approaches are robust.

66. Valuation of environmental impacts is, however, **only one factor in decision making**: the results of environmental valuation studies are used to *advise* decision-makers and not to *determine* the decision. In many cases, the chosen option may not be the one with the highest benefit-cost ratio but the one that is more acceptable for political and social reasons. Nevertheless, the economic analysis will show *the cost* of choosing a second-best solution and will enable the decision-maker to assess whether or not this cost is acceptable. Not surprisingly, where the analysis has been developed in close interaction with the decision-makers, the impact on the decisions has generally been greater.

67. **A broader application of economic valuation in the NIS faces some technical and institutional constraints.** The technical constraints, such as limited availability and quality of data, or price distortions, can be overcome by careful design and execution of the analysis. Institutional constraints present a bigger challenge because of:

- **Limited regional capacity and expertise** to undertake economic valuations. Despite training efforts by local and international institutions, the circle of regional experts remains small and heavy reliance on costly international expertise continues.
- **Outdated regulations.** Use of more-reliable economic valuation studies in formal decision making is constrained by regulations which still prescribe the use of an outdated “Metodika.”
- **Lack of transparency.** Decision-making on investments and expenditures is not subject to public consultation.
- **Skepticism.** Decision makers question the reliability of the results.

Recommendations

68. A broader application of economic valuation of the environment would benefit not only environmental authorities, but also decision-makers in ministries of finance and economy or at the sub-national level. The private sector would also benefit from information directing scarce resources to areas of major environmental impact.

69. A broader application will require (i) a regional capacity-building program, (ii) revision of procedures for economic valuation of environmental costs and benefits; and (iii) incorporation of full cost-benefit considerations into the decision making process.

70. **Capacity-Building Program.** Building on initial efforts by local and international institutions, NIS countries could pursue a three-pronged strategy:

- Expand the training efforts initiated under the EAP Task Force and funded by donors and international organizations through workshops, training-of-trainers, and partnerships between academic organizations;
- Build a strong, professional network of environmental economists in the region, supported by a common web site which would allow for continuous exchange of best practices and results;
- Increase the number of pilot studies, both for the sake of hands-on training and also to generate a body of robust analytical results which could serve as benchmarks for other NIS studies.

71. **Revisions of procedures for economic valuation of environmental costs and benefits.** This would involve the following steps:

- Ministers of finance and environment would establish joint task forces to recommend regulatory changes required to move from an outdated “Metodika” toward the application of modern economic valuation methods in formal decision making. Governments may want to build on the work of a small, region-wide task force that was formed for this purpose in April 2000 at the initiative of several NIS countries.
- The task force would develop a set of guidelines for adoption by the respective governments. It will be important to bear in mind that there is no single, uniform (“cookbook”) approach to economic valuation of the environment. While it is important that the method selected be feasible for use in valuing a specific type of environmental good or service, the merit of a valuation method rests more critically on careful design and execution than on the method itself.

72. **Incorporation of full cost benefit considerations into the decision making process.** This could be achieved through the following measures:

- Recommend that Economic Impact Analyses be produced and included for the consideration of decision-makers when major projects and regulatory changes are proposed. These studies would include estimates of changes in environmental services affected by the measure.
- Recommend that project and regulatory decisions include an estimate of net benefits for each alternative considered by the decision-makers, as well as an explanation of the grounds for the final choice.

ANNEX 1: SUMMARY OF ENVIRONMENTAL VALUATION STUDIES CONDUCTED IN NIS

Name of the study	Study objective	Method	Results	Policy implications
Health risk analysis/management in Volgograd. HIID, Harvard School of Public Health, 1998.	<ul style="list-style-type: none"> To provide guidance on options for least-cost health risk reduction from air pollution (stationary sources) in the industrial city. Capacity building. 	Health risk analysis, involving the following steps: <ul style="list-style-type: none"> hazard identification; exposure assessment; dose-response assessment; risk characterization; risk management; environmental benefits estimation based on benefit transfer approach. 	The five most cost-effective projects, implemented simultaneously, would lead to avoiding 277-966 deaths per year with a total net benefit of US\$ 39.5 million. The costs of the cheapest options were estimated at \$90-200 per life saved.	The study was presented to Russian authorities and experts at a series of round tables. The results provided guidelines for environmental funds.
Assessment of the relative cost-effectiveness of options for reducing environmental health impacts of industrial emissions. Center for Preparation and Implementation of International Projects on Technical Assistance (CPPI), 1998-1999.	<ul style="list-style-type: none"> To demonstrate risk assessment and cost-effectiveness analysis as techniques for priority setting at a local scale. To provide practical advice regarding several environmental investment projects proposed under the "Federal Program for Environmental and Population Health Remediation in Cherepovets." 	Health risk analysis. Data on pollution emissions from the plant were used as an input to an air dispersion model (USEPA model was used) to estimate the concentrations of pollutants in the air in the city before and after investment. Morbidity was taken into account as well. Risk reduction investment options were ranked based on cost-effectiveness ratio.	The study indicated control measures would result in potential annual reductions of 300 cases of cancer, 55 deaths and 1000 cases of acute respiratory symptoms due to TSP and SO ₂ . Highest priority identified was investments that improved production and for which environmental benefits were an added benefit.	Investments under the Federal Programs for Severstal Iron and Steel Works were undertaken on the basis of study recommendations.

Name of the study	Study objective	Method	Results	Policy implications
Multi-media health risk analysis in Verkhnyaya Pyshma Center for Preparation and Implementation of International Projects on Technical Assistance (CPPI), in 1998-1999.	<ul style="list-style-type: none"> To adjust US EPA health risk assessment methodology to the Russian context. Capacity building. 	Health risk analysis based on US EPA approach. Hazard identification was based on actual monitoring data. Exposure assessment was based on concentrations of pollutants from monitoring data on pollution of environmental media (ambient air, soil, drinking water, and food).	Ranking of environmental risks based on damages to population health: Rank 1 – Lead; Rank 2 – TSP, NO ₂ , SO ₂ (in total); Rank 3 – As, Cd; Rank 4 – Cu; Rank 5 – Other environmental pollutants.	Russian Federal and Sverdlovsk Regional Authorities officially approved this approach. The study produced some recommendations for the Federal and regional SanEpid on means to improve the monitoring process.
Health risk assessment in Samara Oblast Conducted by a group of Russian experts, 1999	To assess multimedia health risk in Samara Oblast.	Health risk assessment, US EPA approach. Analysis was based on existing inventory of air and water emissions. Concentrations in air and water were measured with the help of a Russian air dispersion model. The study used benefit transfer approach to estimate WTP for risk avoidance. However, no estimate of the cost of different policies has been provided.	Quantitative characteristics of risk have been developed for the territories studied, for all media. The major medium of cancer risk was atmospheric air, at the level 10^{-3} . WTP for risk avoidance was estimated at US\$ 30,000 per additional non-cancer death and US\$ 300,000 per additional cancer related death.	The study was conducted in close cooperation with Administration and Environmental Authorities of Samara Oblast, providing the authorities with a wide range of legal, institutional and economic policy measures to reduce health risk from environmental pollution.
Environmental valuation in Yaroslavl Oblast: Danilovo case study. Conducted by NGO "Cadastr" under the supervision of HIID.	<ul style="list-style-type: none"> To assess WTP for improved water supply. 	The study applied the CVM approach to estimate WTP of those who do not have tap water for centralized water delivery into their apartments. The survey was arranged as a direct interview with respondents, based on open-ended questions. Respondents were asked to estimate maximum amount of one-time payment they would be willing to make in order to obtain tap water.	Mean of WTP for water supply is about US\$ 0.1/person/month or about US\$ 0.02/m ³ of water. 82 % were willing to pay up to US\$ 30/household for tap water installation, 8% willing to pay US\$ 100, 4% willing to pay more than US\$ 200.	Study recommendations: <ol style="list-style-type: none"> 1. Double water tariffs gradually, simultaneously improving water quality; 2. Subsidize low-income households instead of subsidizing the local water supply company; 3. Increase the scope of pre-paid additional water supply services for households with the highest incomes; 4. Establish a water supply market with competing tariffs from different water providers

Name of the study	Study objective	Method	Results	Policy implications
				5. Spring water sales
Environmental valuation of drinking water in town Chudovo (Novgorod Oblast), 1998.	<ul style="list-style-type: none"> To assess WTP for improved drinking water quality. Capacity building. 	CVM and averting-costs approaches. The main survey was piloted and used both open-ended and discrete choice format. Questions addressed the quality of water, types of avoidance actions and their costs, and, finally, the WTP for specific ways to improve quality of drinking water.	The respondents were willing to pay an additional US\$ 0.5-1.2/m ³ per person/month to improve the water quality. WTA was estimated based on adverse costs at US\$ 8-33/month.	The study proposed policy options to improve the water quality situation in Chudovo but was not well coordinated with local authorities.
Avoiding health risk from drinking water in Moscow. Conducted by HIID, October 1996.	<ul style="list-style-type: none"> To assess attitudes regarding water quality in the city of Moscow. 	Survey of opinions of water quality, cold water supply (water quantity), and risk-avoidance actions.	82-88% of Moscow residents were generally satisfied with the cold water quality from Volga and Moskva rivers.	The results of the study were used for capacity-building, as a case study to educate those participating in the Chudovo survey. Several articles were published in the mass media, provoking a very negative response from Moscvodocanal.
Natural resources accounting in Russia: practical experience in Yaroslavl Oblast. Conducted by Yaroslavl "Cadastr", University of Bath, Institute of System Analysis, Moscow, 1999.	<ul style="list-style-type: none"> To develop natural resources accounting system for the region of Yaroslavl. 	Direct valuation method based on the UN Guidelines for environmental accounts on monetary and non-monetary levels. This method requires accounting of the stock of each natural resource at the end of the year based on the present value approach.	The total value of natural capital in Yaroslavl Oblast (1996) was US\$6.3 billion (19 % of man-made capital). 88% of natural resources value comes from water resources. At the present time the net value of the flow of water resources is very small or even negative.	Results were presented to the oblast authorities and provoked useful discussions about policy changes.
Efficiency and sustainability in natural resources sector of Russia. Regional analysis, conducted by the World Bank and the Higher School of Economics – State	<p>To evaluate natural resources of Samara oblast and to answer the questions:</p> <ul style="list-style-type: none"> What are the major components of natural capital and what is their potential contribution to the regional wealth? 	Direct valuation method to estimate depreciation of the natural capital in Samara oblast, capital value of natural resources, green regional product and net investments. Depreciation of natural capital was estimated based on the change of the capital value of natural capital. Sustainability	Land and oil deposits constitute the main natural wealth of Samara Oblast. Their joint capital value is about 7 billion. R in real terms (1994 prices) or US\$ 2 billion NRP started to grow after 1999. Economic depreciation of natural capital makes further	

Name of the study	Study objective	Method	Results	Policy implications
University, 1999.	<ul style="list-style-type: none"> What are the channels and efficiency of rent distribution and redistribution? How can sustainable development be promoted in the region in terms of changing the capital flows and institutional structure in natural resources use? 	criteria for the region require non-decreasing Net Regional Product (NRP) or positive Net Investment (NI) as a measure of the potential for regional development.	growth problematic without substitution of natural capital for man-made capital after 1999. In 2001, economic depreciation of natural capital would be about one third of the depreciation of man-made capital.	
Forest regeneration assessment in Khabarovsk and Krasnoyarsky Krai. HIID and the U.S. Forest Service in collaboration with the Khabarovsk Kray Forestry Administration, Khabarovsk Forest Service and the Institute for Sustainable Communities, 1998-1999.	<ul style="list-style-type: none"> To select the reforestation methods that are most cost-effective and to identify the sites where they generate the highest returns. 	Estimated future growth of different species in different forest zones. Used discounted cash-flow techniques to calculate the cost per cubic meter of regenerated timber.	On average, cost of artificial regeneration is several times higher than costs of assisted natural regeneration. Carbon sequestration investments are viable in most zones of Krasnoyarsky Kray (lower than 10-20 \$/ton of carbon). The net revenue of non-timber resources (mushrooms and berries) is approximately \$70/hectare.	The Russian Forest Service and regional forest services consider the study one of the first experiences of environmental valuation in the forest sector, which has been financed by public funds without consideration of efficiency.

ANNEX 2

SOME PILOT PROJECTS PROPOSED BY THE NIS FOR FURTHER APPLICATION OF MODERN VALUATION METHODS

Valuation of industrial and domestic waste treatment in Sumgait, Azerbaijan Republic

Sumgait (350000 residents) is located 30km northeast of Baku and has petrochemical industry, metallurgy, power engineering, light industry, etc. The project proposes consideration of different options for wastewater treatment. Currently, the treatment facility is one component of a large chemical plant and carries out only partial waste treatment. Two scenarios are offered for consideration:

- A single treatment system;
- Two separate treatment facilities: one for industrial wastewater and another for domestic wastewater.

Improvement of the water supply in Armenian towns, Armenia

In Armenia, ground water sources account for about 95% of potable water. Water from these sources is of high quality, meeting microbiological and chemical standards. However, an obsolete water distribution system results in substantial water losses (35%-40%) and inadequate supply (on average, tap water is available in households for 1-2 hours per day). The alternatives to improve water supply to be considered are:

- Ensure increased water supply by reducing losses and installing water meters in each household.
- Improve water supply and water quality and introduce a relevant increase in water charges.

The authors proposed to use CVM to evaluate WTP for improved water supply.

Economic benefits of improvement of water supply system and drinking water quality in Kutaisi city, Georgia

Kutaisi (population of 250000) is the second largest city and industrial center of Georgia, situated in the western part of the country in the Black Sea basin. Although the connection rate to the centralized supply network approaches 90%, presently there are virtually no households provided with a 24-hour drinking water supply. The main pipelines supplying the city with groundwater from external aquifers are 46 km in total length. Project alternatives to be evaluated are as follows:

- No action;
- Rehabilitation of pumping stations;
- Rehabilitation of supply network facilities, including pumping stations;
- Rehabilitation of supply network facilities, including pumping stations, and installation of water meters system to introduce user charges.

The authors proposed to use health risk analysis, other direct valuation methods and CVM to assess WTP.

Assessment of health risk from unsafe drinking water in the Republic of Moldova

Water supply in the cities in Moldova is irregular, and water distribution leakage is at a rate of 30%-35%. There are no household meters. The issue of municipal services privatization is under consideration. Cost recovery for water treatment and supply is about 30%. The purpose of the project is to elaborate a strategy and establish priorities for reduction of health risks attributable to consumption of polluted drinking water, applying cost-benefit analysis, estimating WTP with a contingent valuation approach, and considering cost-effectiveness.

Project alternatives are:

- Health risk assessment in the current situation (no-action);
- Improvement of water treatment;
- Modernization of the water distribution system.

Valuation of projects to improve potable water quality in a district of Kyiv, Ukraine

Kyiv has a population of 2.6 million, of whom 100% have access to the central water-distribution system. Water intake is primarily from the Desna and Dnieper Rivers, both classified by the State Committee for Statistics of Ukraine as sustaining an anthropogenic environmental stress. The goal of the pilot project is to assess proposed improvements of potable water quality in a Kyiv district. Project alternatives are:

1. Technical: Measures aimed at improvement of potable water quality:
 - Building a new purification plant at the municipal water supply facility;
 - Renovation of the municipal water supply infrastructure.
2. Institutional: Development of recommendations on improvement of potable water quality, in close cooperation with the municipal authorities, environmental agencies and water management bodies.

The authors proposed application of the “human capital” approach to evaluate the costs and benefits associated with a reduction of health risk due to water pollution and to apply cost-effectiveness analysis to evaluate available options for improvement of potable water quality.

Evaluation of the socio-economic costs and benefits of the development of Kolkheti National Park, Georgia

The Kolkheti Lowland region is located in the Western part of Georgia and is bordered by the Black Sea. The most important parts of the region are its wetlands, which include bogs, marshes, swamps and salt marshes. The flora of the site is diverse, and includes a variety of endemic and relict species. Due to the region’s high environmental importance, in order to save the area from further degradation the Central Kolkheti wetlands were recognized as a RAMSAR convention site in 1996. The Kolkheti National Park is intended to become one of the major recreational sites of the Georgian Black Sea coast. The purpose of the project is to evaluate socio-economic benefits related to the establishment and development of the Kolkheti National Park as well as the opportunity cost of foregoing the use of the wetlands and adjacent areas for conventional economic purposes such as pit extraction, hunting, fishing, grazing, infrastructure development.

Valuation of health risk to the population of Bishkek from air pollution related to automobile emissions, Kyrgyzstan

Bishkek, the capital of Kyrgyzstan, has a population of 619900, more than 13% of the nation's total. In Bishkek, the major sources of pollution are automobiles. About 40% of privately owned automobiles do not meet national norms limiting smoke and toxicity of exhausts. The number of gas stations has increased sharply over the past few years. Automobiles are currently the major source of certain pollutants, including nitric oxides (2.5 MAC), formaldehyde (5 to 10 MAC), benzopyrene (20 to 60 MAC), and suspended particles (3 to 10 MAC). In terms of the gross pollution load, however, the main pollutant is suspended particles (about 50% of total pollution).

The project objective is to assess the economic benefits of improved air pollution control in different districts of Bishkek, based on health risk analysis and estimation of economic damage from transportation.

Project alternatives are:

- No action;
- Regulation of the import of low-quality automobile fuel and automobiles in poor condition, based on testing for PM10, PM2.5, etc.;
- Optimization of the transport network (designing overpasses, erection of noise barriers), increasing the amount of green planting by way of "Ashara" method (sponsored collective work).

An economic analysis would form the basis of recommendations on economic priority-setting for decision-makers.