CENTRE FOR ENVIRONMENTAL STUDIES

ECONOMIC EVALUATION OF THE GABCIKOVO-NAGYMAROS PROJECT

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I. THE THEORETICAL FRAMEWORK OF THE ECONOMIC EVALUATION

1.1. The new investigation of environmental economists

In the thinking about environment even more important is the development that has taken place in the human perception of the environment. David Pearce, a world famous environmental economist and World Bank expert, emphasizes this fact in his newest book:

"Economist Kenneth Boulding coined the phrases `cowboy economy` and `spaceship economy` to characterize the transition in human perception of the natural environment in the twentieth century. The cowboy symbolizes man's view of the natural environment as a new domain, a frontier, to be conquered and civilized. The cowboy economy is an open system which is maintained by resource and energy inputs which then become wastes, or outputs of the system. This contrasts with the economy as a closed system, in which inputs are, as far as possible, transformed into outputs which are then returned to the system through recycling and re-use. As mankind perceives the `limits` of economic activity in terms of the effects on the environment, so economic activity should be reorganized to increase recycling and re-use of materials, and to substitute unlimited energy flows based on solar energy for the embodied solar energy of fossil fuels.

Boulding`s vision has done much to influence the nature of environmental thinking. In its most provoking sense it can be taken to imply that the `throughput` of the economy is not something to be maximized, but something to be minimized. What matters is not throughput (the economic analogue of which is GNP) but the stock of wealth, including the stock of knowledge and human well-being and the stock of environmental assets. The idea that it is this stock that needs to be maintained and expanded underlies a good part the modern thinking about `sustainable development." (Pearce[1], 1993. p. 2)

In the basic decision making concerning the establishment of the Gabcikovo-Nagymaros Dam economic investigations of that time were built on the traditional economic approach, that is the paradigm of the

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[1]David Pearce: Economic values and the natural world CSERGE-EARTHSCAN London 1993.

`cowboy economy`, and appropriate methods were used, principally the traditional methods of cost-benefit analysis aimed at taking account of tangible factors. However, these method were established for economic analysis of purely private goods and services.

It has to be emphasized, however that "Making choices in the context of environmental quality therefore is more complex than making choices in the context of purely private goods and services. What has to be compared is one priced good (the private good) and one unpriced one (the public good) - as when deciding to invest in air pollution control rather than new economic output capacity. Alternatively, the comparison may be between two or more unpriced public goods - air quality versus water quality, for example. To make comparisons involving unpriced goods, it is necessary to impute a value to the environmental good or service. The discipline of environmental economics has developed techniques whereby such values can be imputed."[2]

In the course of our economic investigations concerning the Gabcikovo-Nagymaros Dam, our starting points were the assumptions of the environmental approach concerned to be valid by us, that is we have not accepted the approach of `cowboy economy`, but rather the `spaceship economy` and we used the methods appropriate to the latter.

Nevertheless, we have to emphasize that even the methods applied by us do not completely embrace all the factors playing a role in environmental decisions. Now we are able to include several factors and imponderables into the environmental economical analysis that used to be considered intangible, but not all of them by far. Consequently the economic investigation is not solely applicable for complete synthetization or integration, and in itself is not a conclusive proof.

Actually that was also the case in the course of the economic investigations using traditional methods in 1989 before the cancellation of the construction of Nagymaros and the decision of the Hungarian parliament considered not only the results of economic investigations.

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[2]David Pearce: Economic Values and the natural world CSERGE EARTHSCAN Publications Ltd, London 1993 p.4.

Below we take out significant parts from the methodological study of 1993 of World Bank to underline the methodological validity of our economic investigations.[3,4]

"Because of the world-wide concern about the environment, greater emphasis is being placed on environmental sustainability as an important criterion for sound natural resource management. More attention is also being given to inter-generational equity and the role of discount rates in economic calculations. At the World Bank, this growing interest in environmental issues over the past decades culminated in November 1989 in the issuing of the environmental assessments operational directive (EAOD), which makes environmental impact assessment mandatory for all Bank projects. Thus environmental analysis has been elevated to the same level of importance as the three traditional aspects of project evaluation: financial, economic, and technical analyses. The valuation of environmental impacts takes on added urgency in this context, to help environmental concerns become incorporated into the normal process of decision making in all Bank operations."[5]

1.2. Background of doing economic analysis

The World Bank, a major developer and use of economic analysis for project evaluation, presents the critical elements of a cost-benefit analysis as follows:

"Economic analysis of projects differs from financial analysis. The latter focuses on the money profits accruing to the project entity. Financial indicators based on both the stocks and flows of financial resources are used to address issues such as the entity's ability to meet

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[3]The text was abstracted <in sequence but not completely> from pages 198-207 of Ernst Lutz and Mohan Munasinghe: Integration of Economic Concerns into Economic Analyses with Special Emphasis on Valuation Issues (p. 198- 207) in Toward Improved Accounting for the Environment edited by Ernst Lutz, An UNSTAT-World Bank Symposium, The World Bank Washington, D.C. May, 1993.

[4]The text is original, but the underlines are made by the Hungarian experts.

[5]The text was abstracted <in sequence but not completely> from page 198 of Accounting for the Environment edited by Ernst Lutz, An UNSTAT-World Bank Symposium, The World Bank Washington, D.C. May, 1993.

its financial obligations and to finance future investments. In contrast, the economic analysis of a project measures the effect on the efficiency objectives with respect to the whole economy."[6]

"In principle, economic analyses are supposed to take into account all the costs and benefits of a project. **In the case of environmental impacts, however, economic analysis has been faced with two basic problems. First, environmental impacts are often difficult to measure in physical terms. Second, even when they can be measured in physical terms, their monetary valuation can be a problem**. All the same, a greater effort needs to be made to "internalize" as many environmental costs and benefits as possible by measuring them in money terms and integrating these values into the economic appraisal.

The main purpose of the economic analysis of a project is to ascertain whether the project can be expected to create more net benefits than any other mutually exclusive option, including the option of not carrying the project out. The consideration of alternative options is therefore a key feature in proper project analysis. Often, important choices about alternative project options are made early on in the project cycle. These options may differ greatly in their environmental impact as well as their general economic contribution. Therefore, including environmental effects in the early economic analyses, however approximately, should improve the quality of future decision making."[7]

"Interactions between the economic system and the environment are complex and people's understanding of them limited. The ideal would be to have access to a comprehensive model that traces the package of policy reforms through the economic and ecological system. Time

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[6]The text was abstracted <in sequence but not completely> from pages 198-207 of Ernst Lutz and Mohan Munasinghe: Integration of Economic Concerns into Economic Analyses with Special Emphasis on Valuation Issues (p. 199) in Toward Improved Accounting for the Environment edited by Ernst Lutz, An UNSTAT-World Bank Symposium, The World Bank Washington, D.C. May, 1993.

[7]The text was abstracted <in sequence but not completely> from page 199 of Ernst Lutz and Mohan Munasinghe: Integration of Economic Concerns into Economic Analyses with Special Emphasis on Valuation Issues (p. 198- 207) in Toward Improved Accounting for the Environment edited by Ernst Lutz, An UNSTAT-World Bank Symposium, The World Bank Washington, D.C. May, 1993.

and data limitations preclude the use of such models in most developing countries."[8]

1.3. Incorporating Environmental Costs and Benefits into the Economic Analysis of Projects and Policies

"Measuring environmental costs and benefits consists of four principal tasks: (a) determining the physical impacts and relationships, (b) determining their monetary value, (c) discounting, and (d) assessing risk and uncertainty. The methods of valuing environmental effects are of primary interest here.

Physical Impacts and Relationships

The first step in doing environmentally sound economic analyses is to determine the environmental and natural resource impacts of the project or policies in question. These impacts are determined by comparing the "with-project" and the "without-project" scenarios. The latter may be difficult to predict, especially in the case of policy-based loans, since is not necessarily a simple projection of existing trends. The level of difficulty varies greatly-from relatively easy tasks, such as determining the solid waste production of an industrial plant, to extremely complex ones, such as estimating the environmental impact of a trade policy reform, the health impact of air pollution, or even the impact of soil erosion on agricultural productivity.

In determining physical impacts, the economist will have to rely on the expertise of engineers, ecologists, agronomists, social scientists, and others who can be of assistance. How far economists can go in their valuation depends on what those other disciplines know about physical relationships. Some physical relationships may not be known well, may be stochastic in nature, or may only occur over the long term.

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[8] The text was abstracted <in sequence but not completely> from pages 198-207 of Ernst Lutz and Mohan Munasinghe: Integration of Economic Concerns into Economic Analyses with Special Emphasis on Valuation Issues (p. 198- 207) in Toward Improved Accounting for the Environment edited by Ernst Lutz, An UNSTAT-World Bank Symposium, The World Bank Washington, D.C. May, 1993.

The second step in analyzing environmental effects is to determine the physical impacts and relationships. A number of conceptual approaches and techniques have been developed for that purpose. An environmental impact can show itself in a measurable change in production or a change in environmental quality. Depending on the types of effects, different methods are appropriate.

After the physical effects of projects and policies have been determined and, where possible, their monetary value estimated, the next step in the analysis is to calculate the rate at which the cost and benefit streams are to be discounted, as is commonly done in cost-benefit analysis. This is a particularly important step where environmental costs and benefits are concerned, since at least some of them are long term in nature.

It has been suggested that lower discount rates should be used for environmental projects with long run benefits. If they were used, the ecologically sound activities would pass the cost-benefit test more frequently, with the result that a larger number of projects would pass the test and thereby put additional stress on the environment. In addition, short and long-term costs and benefits should be estimated with great care, and close attention given to non-monetary consequences (including those that might be irreversible).

Risk and Uncertainty

Projects and policies alike carry risks and uncertainties. Risks arise when probabilities can be assigned to the likelihood that an event (such as an industrial accident) will occur. Uncertainty arises when little is known about future impacts and therefore no probabilities can be assigned to certain outcomes, or the outcomes are so novel that they cannot be anticipated. Risk can be insured against and treated as a cost, but uncertainty defies actuarial principles because of the novelty of the outcomes.

Uncertainty is especially important where environmental issues are concerned, particularly as projects grow larger in scale and introduce novel substances into the environments. Risk becomes less relevant in these cases. Risk should be counted as a cost in expected value formulations, but uncertainty should be treated with great caution - if one cannot see very far ahead, slow down.

Public decision-making must take into account the effects of environmental degradation if societies hope to manage their natural resources efficiently and formulate a practical strategy for sustainable development. In particular, the economic analysis of projects and policies can help a country invest its scarce resources in a way that will contribute to such objectives. "External factors" have often been neglected in the past, but these should now be internalized. It is important to consider and, to the extent possible, rigorously analyze consequences and risks that cannot be measured in monetary terms....Such an approach, together with sound judgment, are at present the best inputs into decision-making."[9]

1.4. Critical Issues Related to the Economic Calculations of the Investments of the Gabcikovo-Nagymaros Dam Project

1.4.1. The recent development in investment decisions

Even if the partial economic calculations did not establish the decisions about the cancellation of the dam project or about stopping the construction on the Hungarian side, it is not an anachronism to present and demonstrate the rightfulness of the decision to halt on the basis of the current status of economics. Termination of the GNB Treaties, on the Hungarian side, from the economic point of view is based primarily on two findings:

a.) The proposal to construct the dam was born under such conditions that economic considerations had no importance, thus the usual economic criteria did not play a role in the decision.

In 1988-1989 the collapse of the system was clearly imminent, similarly even for state investments it is impossible to use different rules (tariffs, credit conditions, taxes, etc.) than the legally prescribed ones.

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[9] The text was abstracted <in sequence but not completely> from page 200-202 of Ernst Lutz and Mohan Munasinghe: Integration of Economic Concerns into Economic Analyses with Special Emphasis on Valuation Issues (p. 198- 207) in Toward Improved Accounting for the Environment edited by Ernst Lutz, An UNSTAT-World Bank Symposium, The World Bank Washington, D.C. May, 1993.

The investment was planned to be financed primarily from loan, whereas the expected profit would not cover even the interest of such a loans.

b.) After the Brundtland report that conceived the principles of sustainable development the thinking of citizens and governments of the world about the environment has changed. In the United States and the United Kingdom the government initiated the consideration of the natural environment as capital, and of the change in this capital investments decisions.

These thoughts appear in the financing philosophy of the World Bank, too, precisely because of the failure of projects similar to the GNB. The UNDP elaborated by 1992 the Environmental Management Guidelines[10] in order to help UN organizations avoid supporting environmentally harmful projects. These facts prove that at the time of signing the treaties environmental considerations were not among the issues highlighted – even elsewhere in the world – but by the time of termination including these aspects had become an internationally accepted, even compulsory practice.

1.4.2. Preceding issues

1. The following statement can be read in the No. 0-6 "Economic Part" document of the joint agreement plan of the Gabcikovo-Nagymaros Dam (GNB) system:

"The evaluation of the economic efficiency of the investment can be carried out partly on the basis of numerical positive and negative effects, and partly on the basis of further benefits and disadvantages which can be characterized only verbally."

Furthermore, it can be read that:

"Considering that the Hungarian and Czechoslovakian standards and regulations are different, and that the value of certain budget items is not constant in Hungarian Forints and Czechoslovak Korun, a unified and joint economic evaluation of the total system can not be performed expressed in both currencies."(p. 55)

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[10]Handbook and Guidelines for Environmental Management and Sustainable Development, Environment and Natural Resources Group, UNDP, One United Nations Plaza, New York, N.Y. 10017. February 1992.

2. The II/C ADVISER COMMITTEE, formed on the basis of Point 5 of Resolution No. 3205/1989 of the Hungarian Academy of Sciences, which performed a comparative economic analysis of completing the project according to the original plan versus canceling the Nagymaros Dam, made the following interesting statement in its report of August 17, 1989: "The most important consequence of the calculations is that no significant difference can be shown between completing the original project and canceling the Nagymaros Power Station, regarding investment expenditures. The same can be stated about the burdens of the State Budget that are related to the project. This supports our conclusion that the question must be decided with consideration to broader ecological, furthermore, international political and economic aspects." (p. 10)This report emphasized that "in both versions factors of uncertainty play an unusually important role", too.

II. CONCERNS ABOUT THE ORIGINAL ECONOMIC EFFICIENCY CALCULATIONS OF THE GABCIKOVO NAGYMAROS BARRAGE PROJECT: SOME ASPECTS OF THE MAINSTREAM ECONOMICS

2.1. Introduction

It is the conclusion of this study that the decision about the cessation of the Gabcikovo-Nagymaros Barrage (GNB) project was rightful and well founded according to the 1989-92 knowledge and status even on the basis of the ***traditional*** *(mainstream) economic resoning and calculations (not mentioning the methodology including ecological aspects as well, which, in the meantime became more relevant), if actually justified and recognized calculations are considered.* ***There is no way to prove that the original investment decision would have been rational from the economic or financial efficiency point of view.***

The primary reason for which this can be stated is that the *original decision was not based on careful economic and financial calculations that were common in the international practice even, in the 1970s. A number of forms of efficiency calculations of public investments were known even at the time of the investment decision, of which only one, wrongly based and wrongly interpreted form was used in the GNB case.*

The GNB is a major *public investment project*, and in such cases detailed information and comprehensive computations and analysis are required regarding the costs and benefits of the project. Truly, in the case of most public projects pure economic profitability is hardly the exclusive criterion of decision. A government, indeed, is not a business enterprise, yet no government can neglect the economic and financial consequences of major projects. A number of commonly used indices are known to calculate efficiency. Formally, the decision makers use "multicriteria" analysis, which includes both economic and political aspects, but any public project decision is finally a *political* decsision, whatever supporting arguments be behind it.

In the case of the GNB project this political characteristic was obvious. *First,* although the project plans have various chapters on the economic, financial, environmental, energy, infrastructural, etc. issues, the real multicriteria analysis was not applied. A multicriteria decision making is a quite rigourous mathematical and statistical method, and not only putting together several documents made by separate groups of professionals. *Second,* the economic and financial considerations, no doubt, played subordinate part to the political considerations. This can be seen from the fact that although virtually all of the used "efficiency criteria" (e.g. the often cited "D-index") indicated that the expected net present value of the project is negative, i.e. it would not generate any profit or social surplus, the decision was made in favor of the investment. The "Economic Calculations of the GNB, Documen t 06" (further on denoted as "06") even emphasizes that *"the full economic evaluation can not be carried out"*, partly because of the different accounting and financial systems of the participating governments. (It should be noted here that this is not exactly true, since in the international finance literature there were, even at the time of the decision making, known the methods of evaluation of such major international projects. The real difficulty was actually not the lack of methodology but that the existing monetary systems, price structures, and currency rates were artificial in the socialist regimes, thus did not reflect the true cost and efficiency ratios.) The same "06" document admits that the calculations proved the inefficiency of the project. The fact that, in spite of all the above mentioned, the decision was made to start the investment proves that the economic considerations were only secondary to non-economic ones.

It must be kept in mind, too, that the "non-economic" aspects mean not only political ones, although primarily such they are. The *absolute volume* of production - in this case of energy - was an important issue here, too, just in the case of any other decision of state socialism; since the major objective function of that regime was always *absolute quantitative growth* with very little respect to its economic and non-economic costs.

This chapter intends to summarize that *(1)* what logic and methods are usually applied in such public project decisions, *(2)* what was wrong, in the view of the current mainstream economic thinking, in the analysis, calculations, and decision making when the the investment was started, and how should the calculations have been interpreted. We wish to show that *(a)* the assumptions were unrealistic and this could have been seen even at that time, the methods used were not well founded, and *(b)* even on the basis of the assumptions and methods used, no economic or financial security or efficiency could be concluded, thus any "traditional" economic logic should have said "no" to the investment project.

This chapter attempts to be a "pure" economic study, trying to be politically "objective", and considers merely the *traditional (mainstream) economic aspects,* that is, the GNB is seen as any other public investment that should, at least to a certain extent, return in the long run in terms of financial costs and benefits. The (very important) political environment of the decisions is completely ignored here. Direct and indirect environmental, infrastructural, social, etc., spillover and repercussion effects are not considered.

2.2. About the economic logic of public investment decisions

2.2.1 Net present value analysis

According to the generally accepted financial methods and knowledge large investments are usually evaluated on the basis of *net benefits and costs.* This "cost-benefit analysis" (CBA) has several specific forms and formulae, and in the case of investments - because of the long run in which they return - *net present value* (NPV) of all costs and benefits are calculated, that is, future costs and revenues are *discounted* with some discount rate so that they can be expressed in the value of the presently available financial means.

It is important to see that, in general, CBA and NPV analyses are quite broad categories having a number of possible forms to apply, depending on the specific problem. The results may *widely vary,* depending on the cost and benefit elements involved. Public finance literature considers that benefits and costs may be

- real or pecuniary,

real costs and benefits may be

direct or *indirect*,

tangible or *intangible*.

In most classical NPV-type calculations only the *real direct tangible* costs and benefits are included (that is, roughly, those elements which are actually directly accounted).

The longer the time period is, and the greater the (expected) inflation is, the *more important the NPV analysis is,* and the more *sensitive* the results are to the applied assumptions (like the applied discount rate), and to the definition of cost and revenue elements. The well known formula of the *present value* of a future income stream is:

$$PV = \sum_{i=0}^{n} \frac{R_i}{(1+r)^i} \qquad (1)$$

where PV is the present value of the future stream in the present year ("year *0*"), R_i is the income in year i, and r is the discount rate in decimal fraction form, while the considered term is years *0* to n. (This formula includes the present year, the revenue of which is, of course, not discounted.) The formula for *net present value* differs from the above one in the sense that in the numerator there is *net revenue* (revenue minus costs in the given year, R_i - C_i) instead of gross revenue. This formula is used to calculate the profitability of the investment at *private business firms.* Another, related index is the *internal rate of return (IRR),* which is such a hypothetical interest rate that gives the NPV of a given investment zero value:

$$NPV = \sum_{i=0}^{n} \frac{R_i - C_i}{(1+irr)^i} = 0 \qquad (2)$$

where *irr* is the "internal rate of return, that is, the hypothetical interest rate that solves this equation. If the *irr* calculated this way is lower than the actual market interest rate, then the project should *not* be implemented. The overall logic of the *irr* is that *any investment should "bring" at least as much profits as a normal bank deposit would if the same money assets were placed in a bank.* If the *irr* is the same as the actual bank interest rate, than the relevant NPV will give zero value.

It can be seen, that these indicators are very sensitive to the discount rate as well as to the *contents* of the cost and revenue elements. Furthermore, the *time distribution* of these elements can fundamentally influence the value of the indices. For example, if the revenue will shift to later periods, the NPV will be smaller, and so on.

The NPV-type calculations have various forms. Revenues and costs may be defined in many different ways, and it is also possible to take the *ratio* of revenues and costs instead of their difference when calculating the net present value, etc. However, once correctly interpreted, each form, *provided they all use the same data set,* should give the same conclusion. That is, *it is not possible that, e.g. the "difference" form of the NPV concluded that the investment is profitable while the "ratio" form of it with the same data concluded that it is not.*

2.2.2. Multicriteria analysis and project evaluation

The NPV-type efficiency calculations can be, as it was mentioned above, "manipulated" many ways with the *definition* and selection of the data used. The longer the project calculation period is the more carefully the future cost and revenue estimations should be carried out. Various interest rate levels, discount rates, inflation rates, cost and revenue flow changes are taken into consideration.

This pure economic, or rather *financial* logic of project efficiency evaluation then, in the case of public investment projects, is accompanied by several other types of "desirability" analyses. Assume that the economic/financial efficiency is evaluated by a carefully founded and computed NPV, it will give one number (like how many billions is the financial net present value of the project). Then the other types of analyses also give a certain result, and all these can be summarized into a *vector,* for example:

$$V = (NPV, irr, X1, X2, ..., XN) \quad (3)$$

where $X1...XN$ are the results of other types of analyses,. like expected environmental, infrastructural, social, political, etc. effects.

Then various *weights* are given to the various aspects of the project, and a number of *project evaluation* methods are known in statistics to find out the final desirability of the project. However, before this final step a number of *variants* might be taken into consideration, for various conditions in the future. This will give different V vector for each variant, so we receive a set of vectors, the elements of which may be ordered into a matrix.

$$V_1 = (NPV_1, irr_1, X1_1, X2_1, ..., XN_1)$$

$$V_2 = (NPV_2, irr_2, X1_2, X2_2, ..., XN_2)$$

....

$$V_m = (NPV_m, irr_m, X1_m, X2_m, ..., XN_m)$$

where the various V_j vectors belong to different variants of the *conditions* of the project. These variants may differ in economic terms (e.g. what happens if there is high inflation, if bank interest rise, if there is budget deficit, if foreign debts increase, etc.,) or in any other, political, social, environmental terms (e.g. what if there is a change in the *partner* country, if there is a change in laws or regulations, if unexpected environmental changes occur, etc.). The V_j variant may be assigned a p_j probability, while the x_i elements are assigned w_i social weight, and this is the basis for a careful *political* decision. (There are a number of specific mathematical methods to do the actual calculations further on, which can not be discussed in this chapter.)

It must be remembereded that, even in such a complex multicriteria analysis, the final decision is a political decision. However, if it is based on the above described complex project evaluation, the *considered and neglected factors will be clear, and the decision makers will clearly see what they can gain or lose.*

In summary, it must be emphasized that *merely because a project analysis has "Chapters" or supporting studies on environmental, infratstructural, etc., effects, it will not be a multicriteria decision by itself, because the various aspects are not integrated into one complex decision method.*

2.2.3 Choosing the discount rate

The role of discounting is to transform future costs and revenues into present value. It is important to keep in mind, that a positive discount rate should be applied even *if the inflation rate is zero.* The discount rate is not only for deflating the amounts that are expressed in money with less purchasing power, but, primarily, to reflect time preferences. This is why the discount rate is related to the *real* interest rate, which already has taken inflation into account.

Finding "the right" discount rate is never easy and, whatever discount rate has been chosen, it can always be challenged. The reason is that, in theory, the state/government *does not have the right* to apply any discount rate for the future (apart from the one that offsets inflation), because it would mean a "prescription" for the society that how society *should* evaluate costs and benefits. The practical reason is, on the other hand, that the interest rate that serves basis for the discount rate is, to some extent, the *opportunity cost* of the capital involved. However, the alternatives for the state budget are quite different from that of private business (i.e. the government can not place its entire annual budget into the bank and wait for the interests).

Nevertheless, in project evaluation some discount rate must be applied. *First,* the basic interest rate should be chosen, which is usually not the private business bank interest, but rather closer to some long run safe deposits, like *after-tax interest rate of long run (e.g. 30 year) government treasury bills or bonds.*

Second, the basic interest rate can be adjusted, *or*, several *variants* of it must be taken into consideration, according to, for example, one or more of the following:

- *Inflation.* Discounting usually involves *real* discount rate without inflation. However, in some cases it may consider inflation as well, although it is hard to foresee its rate for a long run.. If significant inflation can be expected, a cost-benefit analysis can consider it, but the way of calculation of inflation should be made clear. In some cases for this reason nominal interest rates are taken as basis but then usually a constant (or "average") inflation rate is assumed which is hardly followed in the long run actually. The GNB calcualtions use an "average" inflation rate to project the nominal value of future costs and benefits, then discount it with the mentioned 12% discount rate. This means that the D-index calculations *did* consider inflation in the flow of costs and benefits, including the export revenue. If this is the case, a more carefully chosen, and maybe differentiated (between various costs and benefits) inflation rate could have been more appropriate.

- *Uncertainty and risk.* Future prices, loan interest, and other non-economic conditions can significantly change, and some investments are more risky than others, too. There are appropriate formulae for risk-adjusted discount rates, and risk-adjusted NPV calculations.

- *International differences.* The interest rate can take into consideration international differences of interest rates, and currency exchange rates.

- *"Social discount rate"* this means usually the opportunity cost of using public funds for one purpose and not for another public purpose. For example, if there are severe social problems in the given country, like unemployment, poverty, lack of funding health care or pensioners, etc., then the net present value can be adjusted by calculating the opportunity costs that, by taking one project, *funding is withdrawn from another very important place.* This type of opportunity cost of investment is often quite high which seriously may decrease the net present value of the considered project.

Many other such aspects may be taken into account when calculating the net present value. Usually the various "distorting" effects have certain weights in the NPV analysis. In conclusion, it can be noted that it may be quite a mistake to use "*rule of thumb*" discount rates for all types of projects. Rather, each project is different, and the correct discount rate should be very carefully chosen. The "uniform" discount rate has role only when the government has to chose, in the same time, from *alternative* projects that serve similar goal.

The actual practice, however, is still that governments (depending on their own country's circumstances, economies, stability, etc.) use one or several "usual" discount rates. For example, in the USA in the 1980s the federal government authorities used 7 to 10 percent interest rates for discounting, and not too much economic rationale is given for these rates. The rates usually reflect *the yield of the long-term US government bonds.*

One more important thing must be added here. Only because the discount rate is calculated from the interest rate, *this does not mean that with this all the interest rates related to the project are taken into account*! Just the opposite: discounting is an evaluation, but not a cost accounting method. That is, foreign and domestic loans borrowed for financing the investment have their own interest, which is cost element. It is a major mistake, therefore, if all the interest rates are set at a uniform level. At least the following must be separately seen:

- *the basic discount rate,*
- *the interest rate paid for the loans borrowed,*
- *the interest rate paid for foreign loans,*
- *the price deflator in case of inflation,*
- *the factor reflecting risk and uncertainty.*

Some of these should be considered among the cost elements and some *modify* the NPV formula or the discount rate itself. Anyway, they must be *separately* discussued, analyzed, and handled in the public project evaluation documents. This is increasingly true when, like in the case of the GNB, *foreign* involvement is very important.

2.3. Problems of the gnb calculations from the economic point of view

2.3.1 The "D-index" used

At the time of the decision, in the system of "central planning" one of the most generally used decision criterion, from the economic efficiency point of view, was the so-called D-index,[11] the "official" formula of which is:

$$D=\frac{\sum_{i=1}^{15}0.89^{i}(R_i-C_i)}{\sum_{i=1}^{15}0.89^{i}CK_i-0.18K_n}$$

where C_i includes the all costs of operations (excluding costs of new investments and developments), R_i is net revenue, CK_i is the capital costs, in the i^{th} year; while K_n means the net remaining value of assets at the end of the 15th year.

This index was commonly used in the time of the decision making about GNB. It was almost an exclusive measurement of the efficiency of all proposed investments, regardles to the nature or length of the project. It can be seen that, from the methodology point of view it is an applied form of the NPV: it relates the net present value of revenues in 15 years to the NPV of the total development and investment costs during the same period.

The "magic" multipliers are related to the "chosen" discount rate: 0.89 is roughly 1/(1+0.12), and 0.18 is approximately 0.89 raised to the power of 15. For the moment let us leave the discussion for later that why these numbers had been chosen.

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[11] The sources of the references to the D-index, its constant and components, discount rate, time run, the inflation rate, etc., are the Appendices No. 40 to 52 of the "Information on the status of the Gabcikovo Nagymaros Barrage System investments", Budapest, 1988. This material was prepared by the Ministry of Environmental Protection and Water Economy for the discussion of the Hungarian Parliament. Its Appendices 40 to 52 contain the numbers used for calculations, including the elements of the D-index.

The D-index was supposed to measure that "in a uniform time period how many times will the expenditures from the net social revenue return". From this it follows that, for a one time (that is, zero net) return in fifteen years, *D=1.00* was expected. Any lower number indicates that the project will not return in the next 15 years, that is, for fifteen years it produces only financial loss. A private business would obviously not invest in any project that has a D-index below one.

The fact itself, that the government authorities, at that time used the D-index, can not be judged independently of the political circumstances, because it was the common practice. It is important to see, however, that it was supposed to be a *relative* index. It contains a *"uniformly"* chosen time period (15 years), and a *uniform* discount rate (12 %). This means, considering the above mentioned about the necessity for flexibly and individually constructed index numbers at financial decisions, that *the use of the D-index has sense only if the decision makers intend to compare similar investment variants in the same time, for the same purpose, and for the same time length.*

However, this was *not* the case when deciding about the GNB. There was no alternative project examined in the same time. The only "alternative" it was compared to was the Paks Nuclear Power station. To be more exact, the two projects were not compared in the project evaluation sense, only once it is referred to that the D-index for the Paks Nuclear Power Station had exactly the same value than the GNB has. (Isn't it amazing that two entirely different projects happen to have the same D-index to the third digit, namely both had *0.981*?) This can not be considered as "alternative" project.

It has not much sense, therefore, support the arguments in this case with a D-index, especially when its value is below one. It did not has any sense either to compare it to the similar value of the Paks Power Station, because the decisions were made in different times under different circumstances.

2.3.2 Constants used in the D-index

The two "magic" constants used uniformly in the D-index were the 12 percent interest rate for discounting (officially called "efficiency requirement"), and the 15 years time run. *Neither of these had any economic grounds, or if they did, no explanation was ever revealed.*

The discount rate seems quite arbitrary in the calculations, or rather, a "rule of thumb" number. Indeed, it was referred to above that this was a common practice in public project evaluation, but it should be remembered, that *(1)* it is also common to attempt to justify why the discount rate has the given value, and *(2)* in most cases it is actually related to some investment or deposit options, like long term government bonds. Neither of these was the case at the GNB decision.

Considering the permanently high inflation rate, the long time horizont, and the involved risk, the applied 12 percent seems to be too low for serving as a basis for the calculations of the NPV of the project. If inflation rate is considered in CBA then usually nominal and not real interest rate is considered, too. The interest rate actually charged by the Hungarian National Bank (MNB) was "well below the market rate", and even the model itself applied 5 percent inflation for the whole time length. Then, using nominal interest rate because of the inflation, discounting should have been *stronger*, i.e. the applied rate higher than 12 percent. In that case, however, the expected revenues, which appear farther in time than most of the expenditures, may have been discounted more significantly and the project may have shown even worse efficiency. In the considered 15 years the investment *can never return.*

According to the original D-index calculations the development and investment expenditures run out in 1994, and most of the net revenue begins to flow in 1992. That is, first we invest a large amount and then, very slowly, receive the benefits. It can be then understood that the higher the discount rate is the worse the efficiency.

The 12 % discount basis seems unrealistic, but it was a "rule of thumb". However, *besides* it could have been used some more realistic NPV calculation, as it was indicated above in Section 2.

The other constant, 15 years, is arbitrary and unexplained "thumb rule" again, but does not influence the results as significantly as the discount rate or the definition of costs and revenues. (Considering longer period, for example, would lead to more revenue flow relatively to the expenditures, because revenues are later in time than expenditures. Even if they are strongly discounted, this would increase the value of the D-index).

It is not merely the "unprofessionalism" of the decision makers that they used the D-index as a major decision supporting calculation, but rather the common practice. They had to calculate it so they did, but the real argument in the entire process for the investment was primarily *verbal.*

2.3.3 Conclusions from the D-index

It was the conclusion of the calculations that the GNB project, from financial and classical economic point of view would not return.

The efficiency calculations were computed for 4, 7, and 12 % "efficiency requirement", and for each of these the net present value is *negative,* the net discounted value of the return of the project was *-19.7 thousand million forints* at the "required" 12 percent "efficiency". This is a significant loss. If the "efficiency requirement" used for the discount rate is decreased to 7, or 4 percent, then the loss diminishes but the net present value is still strongly negative. This is interpreted by the supporting studies that "the efficiency increases", which interpretation is strange, because from this point of view the "efficiency increases" most if the construction will not even begin.

The *irr*, the internal rate of return - which makes NPV zero and the minimum requirement of efficiency - is calculated *between 1 and 2 percent.* This means that, formally, a businessman would consider this project *minimally profitable only if the market interest rate dropped below 2 percent, which is quite irrealistic.*

The conclusion of the calculations, therefore should have been, *even if the assumed cost and revenue data are accepted,* that this project should not be carried out. The document, however, simply states the value of the D-index (0.981), lists the variables used (12 percent, 15 years, etc.), and goes on with lengthy and confusing *verbal arguments* , explaining pros and contras, but hardly doing anything with real financial calculations.

The only correct conclusion what the economists should have drawn from the efficiency calculations should have been that "*From the strict economic point of view this project is not efficient, since its net present value is negative under the usual conditions. Therefore, from the economic point of view it can not be suggested, other aspects must be taken into consideration.*" However, it obviously did not matter what the index showed, the verbal arguments played much more important role. The reason for this was that if decision makers had believed in pure *numbers*, the investment would not have been started. But in verbal argumentation economic facts could be well mixed with and hidden behind political and pseudo-economic reasoning (like emphasizing the role of increased energy production, when nobody had information about its real costs and revenues).

2.4. Weak points in the assumptions of the decision

Let us ignore now the political conditions of the decision, and strict ourselves to the economic ones. These can be characterized as the conditions of the "soft" (i.e. more open, somewhat market oriented) socialism, in which there is already some explicit inflation but not too dangerous, there are serious troubles with socialism but the government believes that with "reforms" it can be saved, etc.

These conditions and assumptions, partly, can be deducted from the available copies of the (parts of the) original efficiency calculations. Let us consider some of these confusing problems of the calculations that were supposed to justify the GNB, at least from the "financial" side.

2.4.1 Macroeconomic assumptions

In the middle of the 1980s it was already clear that the previos "soft socialism" can not be preserved for a long time, and significant reforms can (at least) be expected. The assumed "average" increase of prices for the term of 15 years was 5 percent, which could not be seen as realistic even in the 1980s. If we use higher inflation rate then the discounting should have been significantly stronger, too. Alternatively -

and this would have been a feasible option even if the use of the D-index is “compulsory” - different *variants* of the discount rate could have been used and thus different versions of the D-index would have been calculated.

The exported energy price change was assumed to be 4 percent annually and this was associated with 7.85 % interest paid in ATS. Againd different variants for faster/slower export energy price changes could have been assumed and used.

It must be noted, though, that a faster increase in energy prices, *ceteris paribus,* would increase efficiency (or rather: decrease expected loss), since the loan repayment to Austria is fixed in *value* of the energy and not in Gwhs.

One factor that is hard to tell is the energy need of the Hungarian economy. In the 1970s and 1980s the 1% growth in national income brought about 1.7% increase in electric energy use.

Neglecting the effects (costs and benefits) on the development of infrastructure is a major mistake, too. The effect of this is ambiguous, especially looking from the 1990s when infrastructural development is of extremely great importance.

In the 1980s the collapse of the socialist system and of the COMECON could easily be forcasted. This should have at least raise the question of possible *devaluation of the domestic curreny to the ATS and USD, difficulties in obtaining resources from the formerly usual suppliers, thus a significant increase in all sorts of costs of the project.* Again, this is one more factor to expected inflation and interest rate rise.

2.4.2. *Questions of the data basis.*

It is not clear, first of all, that exactly from what data was the D-index calculated. Formally it needs annual data for all types of costs and revenues. The available material does not allow the analyst to follow these calculations. The printout containing “cost and revenue” elements contains the following main headings:

"Development expenditures (within this: Hungarian, Austrian, and total)",

"Flow cost elements, including labor",

"interest paid,"

"Revenue from the energy production value (Hungarian and export),"

Then values are given for each year between 1885 and 2015 as well as for the sum of years up to 1984. However, *from the available documents it can not be seen clearly proven that exactly what are these "development costs", what are their exact details,, or the "energy production values", or that how exactly these are calculated.* It is not unlikely that these data had no firm basis, or perhaps, were calculated in the same way they usually were: on the basis of "usual numbers".

Furthermore, it should be kept in mind that these values are *very sensitive* to the *time distribution of the revenues and cost. In other words, the simple alteration of the interest/discount rate in such long run investments can not explain themselves the data sensitivity.* For example, in the original documents "development costs" run out in 1994 and "energy revenues" begin to flow in 1990. The energy revenues are relatively large in 1992-1994, as planned, then stabilized at a lower level. In the same time the "export" of energy begins in 2000, and certain numbers are forecast for the (in the time of planning) long run production. Since one of the "strongest" arguments was the export revenue, first the "energy revenue" plans could be challenged.

For one example, it is not clear why the export of energy, as planned in the 1980s, would be increasing steadily (from 19 to 487 Gwhs between 2000 and 2015), and, in the same time, why the maintanance costs would not increase at the same rate (maintanace costs increase from 200 to 1786 million forints in the same period.) This may be true, may be not, one should see "behind" these numbers.

These calculations apparently are based on a *steady, constant, and equal growth of costs and revenues.* The "06" document draws the attention to this constant growth rate at all elements of the calculations. However, economic logic shows that if the revenue flow is shifted "further" from the current period, net present value of the calculation can be decreased strongly, especially at relatively high discount rate. In the same time, cost elements can be increased in the shorter period.

2. 4.3 Verbal analysis parts

In the so-called economic efficiency calculations only a *minor part* is played by "hard" calculations, data and modeling, what we consider now serious economic study. The major part of the document is *verbal argumentation* for the GNB, the statements of which can hardly be checked on. Furthermore, most of the "economic" argumentation is actually technological and engineering data listing, without referring to their source or calculations.

These engineering data, be either correct or not, can hardly be translated as economic analysis. (e.g. a list of annual energy production in Gwhs, kilometers, tons, percents, kilowatts, and cubic meters.) The "economic" interpretation of this officially is merely multiplying them with some price multiplier. An economic study should concentrate on money terms, prices, costs and revenues, and not phyical engineering terms. Therefore this part of the study can hardly be considered as an economic argument.

The mentioned engineering data are not questioned by us, but can not let us to the unanimous conclusion of clear economic efficiency because of the very weak foundations of their transformation possibilities to money terms.

This way of argumentation is very characteristic to state socialism: when 95 % of the managers were engineers and not economists, when the quantitative growth was the most important, the "economic argument" was quantitative, and not financial.

Even these arguments are often so "soft" that one can not do anything with it: "the relatively small drop in production is balanced by the better quality of the energy". What is "relatively small", and what does "better quality energy" mean, is not clear for an economist.

2.5. Conclusions

Our major point in this study is primarily not that the "original calculations for efficiency" were wrong. They were, of course, incorrect, neglecting and missing a number of elements, ignoring the international practice of public project evaluation, not using variants for the discount rates, interest rates, exchange rates, etc. These all are true, and from this point of view it can be said that the *original calculations supporting the necessity of the GNB investment were deficient, inappropriate, and unprofessional.*

Nevertheless, at the time of decision this was the common practice in these countries. Therefore our major argument is that *even considering these deficient and inappropriate calculations the GNB project shows significant loss, therefore there was no economic reason to start such an investment.* Its NPV is strongly negative, and it would be zero only if the interest rates are set at a ridiculously low level, and there is no significant inflation. This was obviously not the case and could not be expected either in the middle of the 1980s.

This way an economist looking at the GNB calculations can only state that **(1) the data and calculations used to justify the GNB are insufficient and inappropriate for such a large decision. It seems to be, from the not well prepared economic calculations, and from that the economic calculations were carried out by engineers, that the entire "economic analysis" behind this political decision was only formal. This was a common case in the former Communist countries, but it was against the international standards at the time. (2) However, if an economic judgment should be stated, on this basis the GNB project should not have been started because it would produce economic loss to the country for a long term, as the D-index points at it. (3) If the politicians wish to add other than economic aspects, it is in their right, but then they can not refer to the any economic efficiency of the project.**

III. THE ECONOMIC EVALUATION OF THE CHANGES IN THE NATURAL CAPITAL

3.1. The short history of economic evaluation of natural resources

(1) Environmental studies of the World Bank unanimously prove that formerly non-numerical but important factors (like biodiversity) can not be ignored any more. Fundamentally there are two approaches used. One quantifies, even more, turns formerly non-quantitative and non-numerical factors into monetary values with relatively reliable methodology. These methods primarily examine willingness to pay, or "construct" present or future hypothetical market, for values of the nature. This approach is primarily used after the initiative of David Pearce[12]. The other approach is used when the important environmental factors cannot be expressed in money, in this case multicriteria decision methods are used (Lutz[13], Munasinghe, 1993). It must be noted that in the stop-go decision of the Nagymaros construction a proven useful Hungarian version of the latter method, the so called POLANO[14] analysis, was used by the Hungarian expert working group. (1989)

(2) The principles and basic methods of the calculation of total economic value[15] are presented in the next paragraph.

From economic standpoint about the GNB, it is worthwhile to evaluate the economic foundations of the investment, and to carry out cost-benefit calculations. However, in addition to carrying out the conventional calculations usual in investment proposals, it would be useful to prove any change in the natural resources which were

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[12] David Pearce: Economic values and the natural world, CSERGE EATHSCAN Publications Ltd, London 1993. p.129.

[13] Toward Improved Accounting for the Environment (ed.) Ernst Lutz, An UNSTAT-World Bank Synposium, The World Bank Washington, D.C. 1993

[14] Protecting an Estuary from Floods-A Policy Analysis of the Oosterschelde Vol.I,Summary Report, Prepared for the Netherlands Rijkswaterstaat (B.F.Goeller, A.F.Abrahamse, J.H.Bigelow, J.G.Bolten, D.M. de Ferranti, J.C. De Haven, T.F. Kirkwood, R.L.Petruschell) R-21/1-Neth December 1977 RAND SANTA MONICA

[15] For more detailed description see: Mohan Munasinghe:Environmental Economics and Sustainable Development, World Bank Environment Paper Number 3, 1993 July p. 19-35. or.

possessed originally by Szigetköz, and in fact, another argument against building the GNB is that the economic proceeds of the plant do not provide coverage for the reduction (depreciation of the natural assets) occurring in the value of natural resources.

These methods are applied in relatively wide circles by the experts of World Bank (Ernst Lutz, Salah El Serafy, Mohan Munasinghe etc.) in preparing development decisions supported in less developed countries. Experience shows that value estimates concerning natural resources are scattered within relatively wide limits. The estimation is relatively more simple for the use value, and so the figure can be more reliable. It is obvious that the value of agricultural and forest management areas lost as a result of flooding can be relatively better specified. It is more difficult to guess how much these areas were worth for example as the habitat of rare species and it is even more difficult to attach a value to a rare and beautiful scenery never being seen again. All these factors could probably be alarming at first sight for natural scientists and engineers. It is impossible to come up with figures for all these, but it is worthwhile to estimate at least for the factors that allow rough outlines according to our current knowledge. The value of one hectare of forest may be estimated also on the basis of the market price of wood and game so this can be applied as a minimum figure. It is obvious of course that the forest is worth more than the wood and game that can be used from it, and how much more, well this could be decided on the basis of contingent valuation or using replacement or other methods.

3.2. The theoretical background of the Total Economic Value concept[16]

Many economists share the view that the main problem of the environment is the non-existence of a market which would be able to measure the price of environmental properties and services such as clean air, the game in the forests, the natural landscape, etc. Economics is the science of choice, if it is required to express our preferences between specified things because our resources are limited, consequently we can only possess one part of the properties and services. If it is considered that in relation to the natural environment we also have to make our choice, the question is whether we should devote our limited resources to safeguarding the clean air or to purchasing a product. It is obvious that we have to choose some option again, i.e., we have to determine our preferences. Since nobody disputes the existence of such a choice, it is also obvious that an improvement in the quality of the environment represents an improvement also in the economic sense, since the well being of the society is enhanced.

Of course the issue is not simple because when we discuss an improvement in the well being of the society, it is not clarified how many future generations we should take into consideration and whether we should regard the "well being" of other living creatures as well and we do not deal with the idea that human concepts about well being do change in time as we believe today. Of course we could go on listing these issues, but it is probably already obvious that when we select between consumer items or retaining the beauty of the natural landscape, "we measure" our preferences; that is, we assign a value to the natural environment.

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[16]Based on David Pearce, Anil Markandya, Edward B.. Barbier:Blueprint for a Green Economy (for The UK Department of the Environment) Eartscan Publications Ltd. LONDON 1989. and Mohan Munasinghe: Environmental Economies and Valuation in Development Decision Making. Feb.1992. Env.Working Paper No.51 World Bank

At first sight, the statement above is generally shocking, especially if we bring up examples like what is the existence of a pelican or a stork worth and a sensitive green person would be angered when asked about this just like an art historian when asked about the value of the Venus statue. The most you could get out of them is that they are invaluable or of an infinite value.

Quite interestingly, in practice the situation is a little bit more simple. Maybe it is advisable to say in advance - just to comfort everyone - that when we intend to determine the value of say the pelican, we do not do this to destroy him afterwards, just as the statue's value becomes quite obvious - expressed in cash - as soon as we take it to an auction.

The assessment of the clean environment can be carried out very simply in many cases. For example in a city with polluted air, the frequency of respiratory diseases is magnitudes higher than in clean air regions. Therefore the costs of medical care are higher and so are the costs of social insurance, due to sick pay, etc. It is necessary to renovate the buildings more frequently because of the corrosive effect of the atmosphere. When expressing all these effects in figures, the value of clean air can be translated into monetary terms.

Why is it important for us to evaluate the environment also in monetary terms? On the one hand because we can guess from the existence of environment protection movements that the demand for clean environment grows among the preferences of the society, but we would like to know about the extent as well. Some ideas are already available about the extent, for example from how many green party MPs are in different Parliaments etc., but they rather indicate the trend and not the extent of qualitative changes in social expectations.

Expressing the strength of social expectations in a monetary form enables us to assess the nature as capital, thereby emphasizing the importance of nature protection. Assessing nature in cash is also significant because if a sufficiently high sum of money is involved, this makes the importance of the problem conceivable and clear for politicians and other decision makers who are used to dealing in tones and front billions. And, thirdly, monetary valuation is also desirable because in this way it becomes possible to make a comparison with other alternatives. Many reject - on an ethical basis - the monetary valuation of natural resources like bio-diversity or certain living creatures. Although political realities made the decision-makers realize that it is impossible to fully eliminate risks and mostly due to economic considerations they were compelled to make compromises. Nature protection is in a similar situation, because in principle all living creatures would be entitled to protection, but because this is an unfeasible demand we are forced to divide our limited resources on the basis of a kind of rationality. In the valuation of natural resources, of course the order of values and the moral condition of the society are expressed. This is because the practical assessment methods investigate in a way how much it is worth to the society or more accurately how much is the society willing to pay for the safeguarding of a national park or a rare plant. This means that each method examines the preferences of the society, the so-called payment will.

Fig 1.: Value components of natural resources[17]

Total economic value				
Use values		**Non Use Values**		
Direct use values	Indirect use values	Options values	Existence values	Other non-use values
-food, -biomass, -recreation, -health	-ecological functions, -flood control, -storm protection	-biodiversity,-conserved habitats	-habitats, -endangered species	

Decreasing "tangibility" of value to individuals

[17]Mohan Munasinghe: Environmental Economies and Valuation in Development Decision Making. Feb.1992. Env.Working Paper No.51 World Bank p.:22.

Determining the value of the natural environment is made more complicated by the fact that environmental economics distinguishes the so-called use value from the non-use value, and the so-called existence value as shown by the split-up in Fig. 1.

The fact is evident to everyone that, for example, for a hunter or tourist using the natural environment has some kind of a monetarily expressed value. It is already more problematic when the economists say that the eventual possibility of use also has a value, i.e., whether in the future I or my great grandchildren can see a whale or the whale's picture. But, in this case, still the use is involved. There is also another part of the value, however, which is much more complicated and that is the sheer existence (intrinsic value) of the natural environment. In this case man acknowledged the right of something, e.g., the natural environment to the right of existence, and is willing to undertake sacrifices for honoring this right. However, this part of the value has nothing to do with the ability of usage.

The total economic value of the natural environment can be calculated on the basis of the following formula:

Total economic value = current use value + option value + intrinsic value.

The value of choice (option value) includes the value of possibility of individual use, the value of the possibility of use by future generations and the value that others may also utilize services provided by nature.

It follows from the discussion above that, for example when we have to make a decision on what structure to build into a natural landscape by which the nature is converted and thereby the natural environment loses from its full economic value, this loss must obviously be taken into consideration in decision-making. In other words a development is only advisable if the economic yields resulting from the development are higher than the sum of development inputs and the profits resulting from leaving the natural environment untouched. If the expected profit is lower, the development is senseless.

3.3. The evaluation methods

Environmental economics has developed numerous practical methods to evaluate the full economic value. Numerous grouping possibilities of the methods are known; we would not like to emphasize any of these. Table 1. reviews assessment methods already tested in practice. The methods are grouped basically according to whether the assessment is based on the current order of values (expressed preferences, price system) or on a future behavior. Within this, the methods are distinguished also on the basis of whether the value of natural resources is determined on the basis of the real value, implicit value or constructed market value.

Table 1.: Accepted valuation methods[18]

	Conventional market	Implicit market	Constructed market
Based on actual behavior	Effect on production Effect on health Defensive Cost Preventive Cost	Travel cost Wage differences Property values Proxy Marketed Goods	Artificial market
Based on potential behavior	Replacement cost Shadow project		Contingent valuation Other

According to a different grouping, direct and indirect methods are distinguished. The so-called direct methods aim at expressing directly in cash the advantages existing in environment quality, for example determining how much better air quality or healthier drinking water is worth. This can be carried out by exploring a market substitute or through experimental methods.

The other group is that of indirect methods, which attempt to estimate the environmental consequences, e.g., health effects of a unit causing pollution, and endeavour to evaluate the consequences in cash. The starting point of indirect methods is the revealing of correlations within natural sciences, but the second phase is similar to the process which will be described briefly below, within the category of direct methods.

[18]Mohan Munasinghe: Environmental Economics and Sustainable Development 1993. Env.Working Paper No.51 World Bank p. 25.

The hedonic price method[19]

It is known by everyone that, for example, in the various areas of a town, the prices of identical standard dwellings are very much different. Obviously, numerous factors make an effect on these prices, like the availability of utilities, transport conditions, the standard of neighbourhood, job opportunities nearby, the network of shops and of course the natural environment, the panorama, the size of green area, air pollution, noise etc. If all these characteristics and the prices of dwellings sold in the neighbourhood are examined, it can be calculated by means of a multi-variant linear regression model - in cash - how much role the environmental factors play in the trend of dwelling prices, i.e., the value of the natural environment (that is landscape endowments, environment pollution etc.) can be identified. This is because a linear regression model can be expressed in the following form:

$$I_{ái} = A_{á} + b_1X_{11}+b_2X_{12}+...+b_nX_{in}$$

where

$I_{ái}$ = the market price of the given real estate

X_{in} = factors influencing the price of the real estate (e.g. availability of utilities, density of houses, transport situation, neighbourhood, the quality of the environment etc.).

$A_{á}$ = basic price of real estate

b_n = importance of the n-th characteristic, which influences the price.

The multi-variant linear regression model can be resolved if the characteristics are selected appropriately and if a sufficient number of

[19] Mohan Munasinghe: Environmental Economics and Sustainable Development. 1993. World Bank Environment Paper Number 3.

observations are carried out. Of course numerous statistical problems come up, the data are difficult to collect and what is more, a high number of characteristics are required to describe the complicated problem, and in this case it may not be ensured that the characteristics are independent of one another. These statistical difficulties can be generally overcome, however, and generally by means of cross-analyses the impact of the environmental characteristic on the price of the real estate can be screened. We are aware of figures about numerous large cities in the U.S., which provide information on how many per cent the real estate price changes when air polluting compounds like for example sulfur dioxide or dust jump 1% in concentration.

Contingent valuation

Perhaps the method most frequently applied in assessing the natural environment is contingent valuation, based on asking people how much they are willing to pay for a certain benefit (e.g. cleaner air) or how much they would ask to tolerate it, that is how much compensation they demand about the deterioration of the environmental quality. The purpose of questioning is to identify a price which would develop if a real market existed for the examined element of the environment.

The Travel Cost Method

The Travel Cost Method is very much preferred for valuating parks and natural tourist sites. The usual starting point is that time is money. Usually a choice can be made whether to go to a park or to use this time for working. If it is also added that an entrance fee is to be paid for entering the park and traveling there also implies costs, a picture can be obtained about how much a visit to the park really costs. There are obviously some who come from a far-away place, there are some who just walk through, there will be some who spend days and there will be some who spend only a few hours in the park. If these data are all known, it can be calculated how much one visit costs to a family. By collecting the data from the visitors, finally a demand function can be drawn up which could serve as a basis for investigations by which it can be determined how much the park has been made more attractive in the monetary sense through the improvement of the services provided by the park or perhaps what effect raising of the entrance fee will have on the visitors.

Perhaps the description above implies that in all the three cases a relatively large data acquisition and processing requirement is to be reckoned with, but it may have also delivered the message that the task is not unresolvable. Of course the results of the methods must be treated with an appropriate criticism, and it is not sure that the best decision is fully in harmony with such types of economic considerations. But, it is pretty sure that a good decision may not leave these considerations totally out of regard.

The above mentioned methods are applied in relatively wide circles by the experts of the World Bank[20] and other UN and EC experts. [21]

3.4. Tangible and intangible risks and damage

3.4.1. Measurability of risks and damage

Before the economic investigations concerning the Gabcikovo-Nagymaros Dam we must say a few words about the role of assumptions in economic investigations. The most often unspoken implicit assumptions play a determinative role in the guidance of investigations. For example, we would get different results depending on whether we considered only tangible assets or beside of them also considered intangible assets.[22]

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[20]Mohan Munashinghe:Economics and Valuation in Development Decision Making, Feb.1992 Environmental Working Paper No 51. World Bank

[21]Interested parties find further examples in the literature listed in R.Kerry Turner, David Pearce,&Ian Bateman:Environmental Economics, an Elementary Introduction p.127-128.

[22] Tangible assets = Physical assets such as plant and machinery, which are distinguished from intangible assets such as the value of a patent or a firm`s goodwill (Pearce, 1986.)

While tangible assets can be measured with more or less accuracy, measurement of intangible assets can be carried out not in a direct but rather in an indirect way, only by the help of proxies, and the scope of it is limited. Preferring quantification beyond measure, can lead to seriously defective decisions, because it does not concern unmeasurables which have real importance and value, if they can not be measured.[23]

Environmental decisions are made typically in such decision situations in which, besides tangible assets, the intangible assets also play an important role. Moreover, closely connected with this fact, consideration of unmeasurables is indispensable.

Due to the development of the science it often happens that factors and impacts used to be qualified as unmeasurables becomes tangible and measurable. These kinds of developments occurred also in the field of environmental economics. It is to be added, however, that the number of unmeasurable factors and impacts is still significant nowadays.

Risks and damage associated with the Barrage System can be analyzed in many dimensions. There are two extremely important dimensions in which a clear picture can be gained about the differing types of risks and damage produced by the Project for Hungary.

One dimension of analyses is the measurability of risks and damage. In this dimension we can distinguish among categories such as "tangible", "intangible" and "unmeasurable". Tangible things can be measured directly. They are defined and described in physical terms. Intangible things are not physical entities. They can be measured only indirectly. Finally, unmeasurable things are so ill-defined and qualitative in nature that they can not be measured at all.

The other dimension of analyses is the system scale risks and damage are associated with. In this dimension we can distinguish among categories such as "economic", "social" and "environmental". Economic risks and damage are relevant at the level of economic activities. Social risks and damage are relevant at the level of the functioning of the society. Finally, environmental risks and damage are relevant at the level of survival of ecosystems.

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[23] Imponderable = of which importance cannot be calculated or measured exactly.

The degree of accountability progressively decreases when we move from tangible economic risks and damage to environmental risks and damage. (Figure 2.)

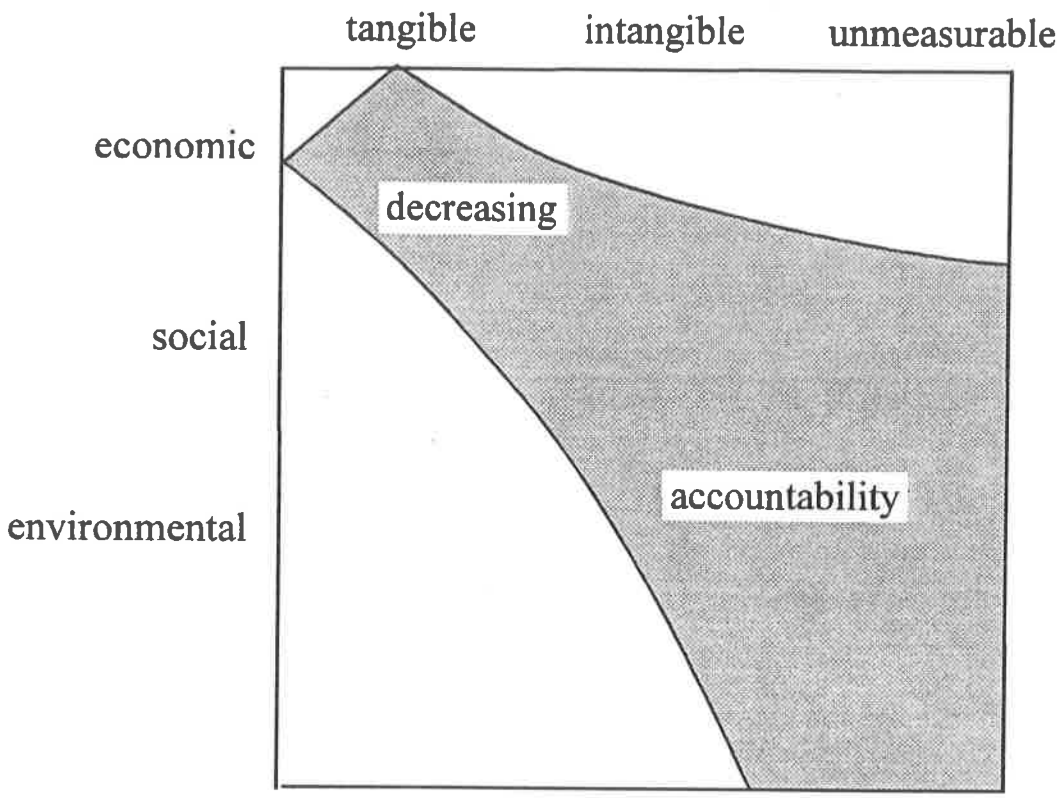

Figure 2. Decreasing Accountability

It is important to note that a particular risk or damage may have different aspects at the same time, e.g., it can be economic and environmental damage. Also, some aspects of a particular risk or damage can be measured while other aspects can not.

3.4.2. Risks and damage for Hungary after realizing Variant C

In the following section only those risks and damage are analyzed which are produced for Hungary after realizing the Variant C of the Original Project. References are made to the Hungarian Memorial.

(1) Deterioration of the groundwater stock below Szigetköz and Zitny Ostrov. 12 000 million m^3 drinking water reserve might become unusable. (para 5.43) This risk is tangible and basically economic in nature.

(2) Drastic decrease of infiltration in the Szigetköz Region. The annual average discharge of the Danube has been considerably reduced (85-97% of average flow). (para 5.52) This damage is tangible and basically economic in nature.

(3) Toxic quality of the waters stored in the Szigetköz Region. (para 5.53) This damage is tangible and basically social in nature.

(4) Decay of forest communities in the Szigetköz Region. Adrop of the groundwater level up to 2 meters has been predicted in the region. (para 5.54) This risk is intangible and environmental in nature.

(5) Ecosystems mis-adaptation in the Szigetköz Region. New types of ecosystems reflecting the altered conditions could develop in the region. (para 5.56) This risk is basically unmeasurable and environmental.

(6) Losses in soil fertility in the Szigetköz Region. The water table location negatively changes the soil structure and thus fertility of the region. (para 5.64) This damage is tangible and basically environmental.

(7) Losses in the agricultural production. Total annual production loss for Hungary and Slovakia would have been equivalent to about 40 000 tons of wheat or equivalent crop. (para 5.71.) This damage is tangible and economic in nature.

(8) Negative influence on the growth and yield of forests in the Szigetköz Region. Changes in the groundwater table and water regime threaten alluvial forests in the region. This area constitutes one of the most important raw material resource for cellulose production. (para 5.73) This damage is tangible and basically economic in nature.

(9) Threatened fish populations. Fish populations that live in strong currents have been forced to disappear due to isolation from the flood plain. (para 5.80) This damage is tangible and environmental.

(10) Threatened plant associations. Along the shoreline plant associations have been threatened because of the changes of groundwater. (para 5.85) This damage is basically intangible and environmental.

(11) Extinction of species and decrease in genetic diversity. A serious percentage decline in the number and the diversity of species has been predicted for the Szigetköz region. (para 5.89) This risk is basically unmeasurable and environmental.

(12) Risk to landscape and recreational values. The drying up of the Szigetköz would causeareas previously available to fisherman, canoeists, bicyclists and others to cease to exists (para 5.93) This risk is intangible and basically social.

(13) Geological and geophysical risks. Seismology of the region is of great concern since the Gabcikovo Barrage is built near a geologically young fault. (para 5.100) This risk is unmeasurable and basically social.

Table 2 shows the composition of risks and damage produced by the Project. Factors (1),..., (13) decrease the Szigetköz region. The total net profit produced by the Project must compensate for this negative value change.

Table 2 Composition of risks and damage of the Project

	tangible	intangible	unmeasurable
economic	(1), (2), (7), (8)		
social	(3)	(12)	(13)
environmental	(6), (9)	(4), (10)	(5), (11)

Note: (.) refers to the points of the analyses.

IV. AN ESTIMATION OF THE TOTAL ECONOMIC VALUE OF SZIGETKÖZ

4.1. Why evaluate Szigetköz ?

It is a consequence of the above mentioned that, when one is to decide about building a physical establishment (e.g., water power station) in a landscape which transforms nature and diminishes the total economic value of the particular natural environment, the possible loss must be evaluated in economic terms before the decision. That is, a development is reasonable **only in the case when the expected economic profit of the development exceeds the depreciation of the natural capital plus normal benefit of the untouched natural environment.**

In practice, the conclusion of the concept of total economic value is that the changes in natural environment, as in capital, must be included into the total costs of an investment. A decrease in the value of natural capital, as a result of the development, increases costs; while an increase in the value of natural capital (e.g., in the case of a nature preservation project) decreases actual costs. **In the case of the GNB project the conclusion is that the expected changes in the Danube basin, as in natural environment, are unanimously negative, a part of which can be expressed numerically, too, in the Table.**

The methods used for the evaluation of the Total Economic Value of Szigetköz are different from the traditional methods described in the literature. A contingent valuation study has not been undertaken on any project in Hungary, hence that Hungarian expertise has not developed sufficiently through experience, and that the political controversies surrounding GNBS are such that an objective Contingent Valuation study may be difficult. That's why other objective approaches are utilized in this analysis.

Instead of using Travel Cost or Contingent Valuation or Hedonic Price[24] methods, the applied methodology combined the traditional Nett

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[24]See for more detaled description: Mohan Munashinghe:Economics and Valuation in Development Decision Making, Feb.1992 Environmental Working Paper No 51. World Bank or

Present Value with replacement cost technics or at least with shadow project approach. One can see from the estimated natural asset value that the table has not given figures for the non-use (or passive use) component of the total value of the Szigetköz assets. For example the hunting possibility as an asset was created from the actual income of hunting and dose not include anything else.

4.2. Major findings estimating the Total Economic Value of Szigetköz

The aim of the calculations was to monetarily evaluate the long term effects of the project including the depreciation of the natural capital.

The major finding in depreciation term are summarized in table 3. while the detailed analysis in this paragraph.

R.Kerry Turner, David Pearce,&Ian Bateman:Environmental Economics, an Elementary Introduction Harvester Wheatsheaf p.108-128.

Table 3. The change in the value of Szigetköz as natural capital according to Variant C and to the "original plan" in million HUF

The evaluated assets	Value change as the consequence of Variant C	Value change as the consequence of "original plan"
Fauna of Szigetköz	min. -128 948 max. - 234 841	min. - 97 688 max. - 156 560
Flora of Szigetköz	min. - 178 574 max . - 324 680	min. - 135 283 max. -216 453
Hungarian water resources used by Slovakian	min. - 13 351 max. - 53 406	min. - 10 547 max. - 42 190
The aquifier below Szigetköz	min. -34 230 max. - 136 875	min. -34 230 max. -136 875
Fishery	min. - 375 max. -1 500	- 375
Game	min. - 417 max. - 625	-417
Forests	-3 700	-1 700
Agriculture	min. -585 max. - 1 114	min. -459 max. - 897
Summa	min. - 360 180 max. - 756 741	min. -280 699 max. - 555 467

Value of the fauna

More than 5000 species of animals live in the Szigetköz region. The number of protected species: 300[25].

The valuation of animal species was based on the monetary value of species as defined by the laws as well as the estimations of numbers/species made by the ecologists.

The 4/1982 law-decree of the President Council had the aim "Preserving the traditions of nature conservation and in order to protect the environment of humans, the aim of this law-decree is to define the regulations of the special protection of certain natural values. Putting the law-decree into practice the OKTH 1/1982 (III. 15) decree , titled "About protected and highly protected plant and animal species, the values of their individuals...." has listed the animal species to be protected or highly protected as well as the monetary values of the species. This decree was modified by KTM 12/1993 (III.31) decree.

We have estimated a minimum capital value of the fauna at Szigetköz as the sum of the monetary value of different species according to the law times the estimated number of individuals of the respective species. (See Appendix 1 and 2 for the detailed list).

One can argue, that the law-decree does not put value for the species but fine for killing individuals of the species. It is probably true that the fine is higher then the value of this species. From the other hand, only about 15 % of the species are protected by law and hence have been included in our valuation. It is likely that these factors are balance out one another and we can rightly state that the fauna at Szigetköz is worth at least **HUF 390 751- 391 401 million.**

However; the actual value is certainly higher than this, because the value of an ecosystem is more than the value of its parts. The monetary values do not reflect the biological value of the species. Non-protected species were not assigned monetary values, although they certainly do have value. Protected animals would not be able to survive without unprotected ones.

Moreover; "...the fauna of the Szigetköz is unique from that of any other river basin because of its special geographical situation. Since the fauna of Szigetköz is enriched with particular species assemblages, its

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[25] See for more detaled description Ferenc Meszaros at all 10.12.1994. Working Paper

species composition is unequaled...Thus not only the highly valuable rare species, but also the species combination and composition of the Szigetköz are unique."[26]

Thus the HUF 390 000 million must be seen as an underestimation or the estimation of the minimum value of the fauna as natural capital.

According to the Hungarian ecologists Variant C will probably cause 33-60% depreciation of the value of the fauna that is HUF 128 948 - 234 841 million. The continuation of the original plan would have caused 25 - 40% depreciation that is HUF 97 688 - 156 560 million. The Appendix shows the value of the fauna as natural capital in its original status under Variant C and if the construction was continued according to the original plans.

Value of the flora

The value of the flora as capital was estimated on the basis of the nature conservation value of plant communities.[27] For plant communities, the actual market price of the land is modified by the rarity score and biological value of the plant associations..

[26] Expert group of the Hungarian Academy of Science: Environmental Risks and Impact associated with the Gabcikovo-Nagymaros Project, Budapest, 1994, p.142-143.

[27] The concept of nature conservation value was defined by Professor Tibor Simon of the Eötvös University, Deparment of Plant Ecology. See: Tibor Simon: Estimation of Nature Conservation Values of Plant Species and Communities, Természetvédelmi Közlöny, 1991/1. 99-114. The concrete monetary values were given also by him.

Table 4. Values of different plant communities:

Associations	Area	Value per ha (Million HUF)	Total value Million HUF
Reed grass associations	150 ha	16.80	2 520
Mocsár-iszap- társulások (swamp associations)	2500 ha	10.70	26 750
Homoki növényzet, pusztagyep társulások (sand and steppe associations)	25 ha	9.50	238
Gyomtársulások (weed associations)	5000 ha	1.06	5 300
Láperdõk társulásai (fenwood associations)	50 ha	24.00	1 200
Füzesek társulásai (Willowy associations)	1200 ha	20.80	24 960
Üde lomberdõk társulásai (broad-leaved forests)	1550 ha	54.30	84 165
Száraz tölgyesek társulásai (Dry oak associations)	1000 ha	74.00	74 000
Nemesnyárasok (Poplars)	4600 ha	70.00	322 000
Total	16075 ha		541 133

According to the Hungarian ecologists Variant "C" will probably cause 33-60% value loss of the value of the flora which is HUF 178 574 - 324 680 million. The continuation of the original plan would have caused 25 - 40% depreciation which is HUF 135 283 - 216 453 million.

Value of the Hungarian water resources used by Slovakia

Because of the diversion of the Danube, its water is not available to Hungary for 39 km. Half of this water discharge should belong to Hungary. The total quantity of water lost by Hungary was 6675.8 million m^3 in 1993.[28] The option value loss for Hungary caused by the local unavailability of the water body flow can be calculated by multiplying the 6 675,8 million m3. by an appropriate water resources user fee.

The level of water resource user fee was determined by 2/1992 (I.6.) Governmental decree. For category II surface water in case of use with economic aim is HUF 0,8 per m3.(Water users without a licence or over license pay 5 HUF per m3 according to the 1992. LXXXIII law and 33/1992 (XII.31) KHVM decree.)

It would be highly unrealistic to suppose that the total flow of water is usable at one time, so the calculation is based on 10 % exploitation rate. Hence the use-type option value loss is HUF 534,06 million per year. From this the option value of the lost water resource capital is between HUF 13 351 million and HUF 53 406 million (Using discount rates 4 % and 1 % respectively.).

According to the original plan the Danube water would not have been available for Hungary at 31 km length. Using the same method of calculation the use type option value loss is HUF 421,9 million per year and the lost water resource capital is between HUF 10 547 million and HUF 42 190 million (using the same discount rates as above).

Game

Hunting gives HUF 5 million per year. Due to Variant C the game carrying capacity of the forest has significantly decreased. The profitability of game management cannot be assured any more, so the branch of hunting will lose this HUF 25 million per year. The capital value change equals HUF 417-625 million using 6 % and 4 % discount rates, respectively..

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[28] Source of data: Hajósy Adrienne: A magyar vízkészletek szlovák igénybevétele és a használat utáni járulék minimális összege a Duna jogtalan elterelése miatt, Budapest, 1994. október.

Forests

The forested area of Szigetköz is 7800 ha. "The site here supports the highest productivity class forests in Hungary."[29] . Calculating the value of the Szigetköz flora the non use value component of the forests has already been reported. Hence, here we just calculate the use value of forests. The value of total standing timber is HUF 4 400 million.

Variant C results in the decrease of forest productivity. The net loss is about 37 000 m3 timber per year.[1] The actual market value of this productivity loss is HUF 37 million which implies HUF 3 700 million capital loss considering 100 year restoration period for the forests. The original plan would have resulted in 17 000 m3 loss in timber production per year. The actual market value of this loss is HUF 17 million. Using the same 1 % discount rate, this implies HUF 1 700 million capital loss in the forests..[30]

The aquifier below Szigetköz

In case of the realization of the original plan "One of the most serious risks of the impoundment is the contamination of the gravel aquifier below Szigetköz and Zitny Ostrov...The 5,000 million m^3 Hungarian part of this reserve has a water exploitation potential of 0.5-1 million m^3 per day. This is recognized as the only large-scale drinking water reserve for the country in the National Water Management Framework Plan of 1984. Approximately 90% of the water in the aquifer is supplied of the flowing Danube --and not by local precipitation and infiltration"[31]

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[29] Dr László Magas: A szigetközben bekövetkezett erdészeti károk és értékvesztés, A hágai peranyag részére, 1994. p.2. The statemnets of this section are based on data from dr. Magar` report. In Austria the price of 1 ha forested land is 100-120 thousend ATS.

[30] Source of data: Dr. Lászlo Magas: A Szigetközben bekövetkezett errdészeti károk és értékvesztés, 1994.

[31] Memorial of the Hungarian Republic, Volume 1. p. 150-151.

The clean up costs of the aquifier for Hungary is about HUF 137 million per year, calculating with an average of 750 000 m^3 per day exploitation and 5 Ft per m^3 water treatment cost. The depreciation due to the contamination can be estimated at HUF 34 230-136 875 million, depending on the chosen discount rate (4% and 1 % respectively).

Fishery

"The entire Hungarian Danube provides a commercial catch of 985,306 kg of fish; of this, 14.1 percent is provided by the Szigetköz region and another 2.5 percent by the Mosoni-Danube. The productivity of the Szigetköz is further supported by data which indicate that it is the location for 80 percent of fish spawning in the Hungarian reach of the Danube.

..."Many species of fish require riverine flow and a sandy or gravelly substrate to successfully spawn or to provide appropriate habitat for food resources. Of the commercial catch, 5 fish species are strictly riverine. The compromise 64 percent of the commercial catch in the main river, and 93 percent and 82 percent of the commercial catch in the Szigetköz and Mosoni-Danube, respectively. These fish species will probably not continue to exist in areas where they are presently found if flow is impounded or drastically reduced."[32]

"According to the prognosis of the Agricultural Bureau of the Ministry of Agriculture in Gyõr-Moson-Sopron County, the decrease of the total fish population will be expected to reach 60% on the Danube section between Bratislava and Komárom as well as in the waterbodies of Kisalföld. The fish population obtainable will decease by 75%, moreover, the decease can be as high as 90% on the most affected upper section. The lost production amounts to at least 100 tons a year (including the haul of fishermen), the gross value of which is 15-20 million Ft (140-185 thousand USD).[33] The value of depreciation is 375-1500 million HUF.

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[32] Memorial of the Republic of Hungary, 1994, Volume 5, p.49.

[33] Dr. Gábor Guti: Economical Damage of Fishery Resultred by the Operation of the Gabcikovo Barrage System and the Estimatewd Natural Importance of the Szigetköz Area, MTA ÖBKI Hungarian Danube Research Station, Göd 1994., p.2.

Moreover, "The Szigetköz region accounts for 80 percent of fish spawning and is home to 14.1 percent of the commercial fish catch in the Hungarian stretch of the Danube. Eliminating the flow of water necessary to support the floodplain ecosystem will undermine the productive base of the entire river."[34] The 375-1500 million HUF depreciation does not include this impact, so must be regarded as an estimation of the minimum value of depreciation.[35]

Agriculture

"The crop yield of wheat, corn, sunflower, and alfalfa, major crops for Hungary, is normally about 15-20% higher in the Kisalföld, including Szigetköz, than nationally, and often of higher quality."[36]

"In the areas near the reservoir, where the groundwater level would have extremely high, shallow rooting crops were to be grown because only the top layer of the soil would have been suitable. In the areas where the groundwater level would have decreased substantially, replacement, deeper rooting crops were to be grown. These would either have been extremely dependent on precipitation, in which case the security of yield would have significantly decreased, or irrigation."[37]

The necessary additional irrigation would have resulted in 459-897 million Ft depreciation of agricultural lands.[38]

The change in the groundwater level will result in 585-1114 million Ft depreciation due to the additional irrigation costs.

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[34] Memorial of the Republic of Hungary, 1994, Volume 5, p.51.

[35] The number doe not include the value of protected fissshes (These are evaluated in the point "Value of the fauna".

[36] Memorial of the Republic of Hungary, Volume 1, p.158.

[37] See above, p. 158.

[38] Source: Palkovics, October, 1994.

Flood Control

"The Danube River, in the reaches affected by the Gabcikovo-Nagymaros project, has long been provided with an extensive system of levees and other structures for flood control purposes. The construction of the project will raise water levels in some places, potentially increasing the risk and severity of floods, while simultaneously raising and improving flood control works. The net effect will apparently be some reduction in the risk of flood, coupled with some increase (at certain locations) in the severity of any floods which may occur."[39]

Navigation

In 1989 it was calculated that in case of abandonment of Nagymaros 2 billion Ft would be needed to improve navigation conditions and 1.1 more to maintain navigation route.[40]

4.3. The result of the evaluation

Based on the aforementioned Total Economic Value concept, from Hungarian standpoint an economic argument against building the GNB is that the economic proceeds of the plant do not provide coverage for the depreciation occurring in the value of natural resources. Due to the fact that the valuation of the Szigetköz (Table 3.) limited itself for only those factors where the value change has evidences yet, and does not cover the majority of the non-use values of the region, the estimated and well documented depreciation is between 3 000 and 7 000 million U.S.D. There is no hope that the project ever cover this natural capital loss.

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[39] Professor John Boland: Ecnomic and Power Generation Issues, Memorial of the Hungarian Republic of Hungary, Volume 5, p.90.

[40] Document P 10/89.

V. NOTES ON LOSSES CALCULATED BY THE SLOVAKIAN LITIGANT

(Chapter IX. section V.)

5.1. Losses resulted in costs and damages to the Hungarian side

Before interpreting the calculations and assessments of the Slovakian side we briefly list the losses which resulted in costs and damages to the Hungarian side.

5.1.1. The Hungarian expenditures related to the construction

Construction costs between 1975 and 1985 that have been spent on preparation and implementation of the project and covered by the government budget amount to 3.2 billion HUF at actual prices that corresponds to 4.5 billion HUF at 1990 prices.

Refinancing loan is provided on the account of internal government debt. The loan contract were signed by the State Development Institute (ÁFI) as the organization managing the construction fund for Gabcikovo Nagymaros Project and by the Hungarian National Bank. in December 1987. The validity of the contract was dated back as starting from 1986. According to this contract the length of the repayment period is 15 years after the grace period that ended at the end of 1990. This loan contract has created the obligation for the central budget to pay back 65 billion HUF (including preferential interest payment) till year 2005 out of which the value of repayable principal was 33.4 billion HUF at the end of 1990.

Funds borrowed from Austria for covering part of the construction costs. The financial burden of this loan can be calculated on the basis of the contract between Hungarian Electric Work and ÖVG (Österreichische Elektrizitatwirtschafts Aktiongesellschaft). This contract has stipulated the payment obligation of 45 billion HUF to be fulfilled through electricity import to Austria over the period of 1995-2003 (10).

The total value of financial obligations - both interest payments and repayment of principals - for the Hungarian side amounts to 1.5 billion

USD. This 1.5 billion USD has not resulted in any completed investment that could have been put into business use therefore activated as assets.

Moreover, dissembling the physical structures deemed useless and reclamation needed about which we do not intend to talk in any detail constitute additional cost. The additional cost impact of these works - depending on the reclamation program - can amount to 25 % of the above mentioned 15 billion USD figure.

5.1.2. Damages from loss of natural values

The volume of assessed damage from loss of natural values, deterioration of environmental quality, and changing conditions for agricultural practices is **3-7 billion USD** as it is described above. The losses listed under point "5.1.1" have different nature than losses in point "5.1.2". The first ones are actual financial burdens, while the later ones are damages expressed in monetary term. The total value of items in point "5.1.1." is given by bank contracts. The changes in the interest rates given in these contracts may cause slight variation (about 2-3 %) in the total value of financial obligations, however, major deviation from the 1.5 billion USD value cannot be expected. This 1.5 billion USD (with 2-3 % variation) does constitute a real burden on the government budget. The total value for part "B" costs may change as a result of some preventive measures, as water pumping, water structures, and so on. These measures, however, also cost money.

5.2. Reflections on the Slovakian position

The Slovakian proposition in section V. of chapter IX. contains other types of losses. We do not intend to review the proposition item by item, our remarks are rather explanatory and supplementary.

The list of losses contains such element as "loss of potential profit" (par. 9.30). We must note that such loss was not accepted in the practice of COMECON countries. To give an example, the Budapest Public Space Management Company (Fõvárosi Közterületfenntartó Vállalat) constructed a communal waste incinerator which could only operate at 50 % capacity for years due to a major failure in the equipment imported from Czechoslovakia (Skoda factory). The prevailing COMECON practice did not allow Hungary to request compensation based on "loss of potential profit". Therefore, such compensation items dated in the COMECON period should not be counted by any of the parties.

The losses listed by the Slovakian party can be categorized in the following way:

1. Costs of needed additional construction (Variant C) (para. 9.34, 9.37)
2. The costs associated with the expanded implementation period (para. 9.35, 9.36)
3. Cost of changes in the technical program (para. 9.38)
4. Losses due to lower than planned energy production (loss of potential profit) (para. 9.39-9.47)

Point 1. The items listed as necessary for accomplishing the investment and are directly connected to implementing and operating Variant C are costs of assets embodied in energy producing equipment and waterways. The operating energy producing system, as well as other related structures are put into the books when regular operation starts therefore they are turned into assets in the enterprise balance sheets. At the first glance, loans listed in para. 9.34 and 9.37 are spending in such structures and account for 109 million USD in the calculated losses. These structures together with other already usable and activated ones some of which have been accomplished as joint Czechoslovakian and Hungarian investments are included into the balance sheets according to their value. They have, therefore market value as going concerns. Potentially, they can be privatized, sold or included as assets into concession contract. We give these examples only to illustrate that it is faulty to include valued and transferable assets with their full value into loss calculation.

Point 2. The total amount of loss due to the delay in putting the investment into regular use is estimated as 10.7 million USD (para. 9.35, 9.36). This relatively small value is difficult to comment on without further information on the types and volume of works needed. These information would be necessary to be able to compare the estimate with Hungarian spending along similar lines (for e.g., towing vessels at the Nagymaros area).

Point 3. The additional costs of navigation and flood protection in the Nagymaros section, as listed in para. 9.38 amount to 11.6 million USD. It is questionable whether these items can be rightly included into the cost calculations. The Hungarian standpoint is that the lawful termination of the Treaty should result in re-establishing the conditions that prevailed before Gabcikovo-Nagymaros Dam constructions along the stretch of the river where water level is not increased. Therefore, navigation and flood control should not entail any extra costs compared to those before the project.

Point 4. (para. 9.39-9.47) The calculations about the loss in electricity production are based, in a somewhat disputable way, on a treaty that is no longer valid. The Hungarian proposition could be the replacement of the invalid Treaty with a new one in which the energy producing potential of the Danube, the border river, would be divided between effected parties. If we assume that the division is 50-50% between Slovak and Hungary then the energy production in either side at the Gabcikovo region should not go beyond that 50% limit. One must note, however, that this new agreement can not justify the ecological threat or damages caused by either of the two parties.

SUMMARY

a) The traditional cost-benefit type calculations, a characteristic of which is that they express both costs and benefits in monetary terms, can serve as economic grounds for decisions in connection with the environment only if all important environmental benefits and disadvantages can be measured in money.

b) The citations from the original document demonstrate that this was not the case, thus in the 1989 Parliament decree stopping the Nagymaros constructions the inevitably partial traditional cost-benefit calculations did not, and could not, play a determinant role.

c) Based on the aforementioned Total Economic Value concept, from Hungarian standpoint an economic argument against building the GNB is that the economic proceeds of the plant do not provide coverage for the depreciation occurring in the value of natural resources. Due to the fact that the valuation of the Szigetköz limited itself for only those factors where the value change has evidences yet, and does not cover the majority of the non-use values of the region, the estimated and well documented depreciation is between 3,000 and 7,000 million U.S.D. There is no hope that the project ever cover this natural capital loss.

d) It should be emphasized that the more comprehensive calculations that include the up-to-date methods of environmental economics have not been performed since that time either; as this can be seen in a chapter which considers new important factors of the 13 December 1993, report of the WWF expert group. (WWF Statement, 1993, pp. 6-7) These methods of analysis have been developed following those new research results in environmental economics which occasionally could be observed since the 1970s but were widely accepted only around the end of the 1980s. This is indicated by the fact that World Bank reports that contain environmental economic calculations were only published in 1992-93 (Pearce and Munanshinge, 1993). It is a right observation of the expert group of the World Bank that the Hungarian data are, comparatively to the Slovak ones, insufficient, but it must be no inter temporal distribution of the particular cost and revenue elements. However, this distribution seems to be arbitrary and seems to lack scientific background of calculations, or at least, it has never been revealed that how this background had been obtained. If the revenue and cost flow given (but hardly explained) by the official government is taken as a basis, it is true that

the lower the discount rate the smaller the loss. Or, if there was any profit, the lower the discount rate the higher the profit would be. But the question in this case was not the profit but the loss! However, it should be kept in mind that these values are very sensitive to the time distribution of the revenues and cost. In other words, the simple alteration of the interest/discount rate in such long run investment calculations is not appropriate to the sensitivity of the data. For example, in the original documents "development costs" run out in 1994 and "energy revenues" begin to flow in 1990. The energy revenues are relatively large in 1992-1994, as planned, then stabilized at a lower level. In the same time the "export" of energy begins in 2000, and, interesting enough, quite exact numbers are given for the (in the time of planning) long run production. Since one of the "strongest" arguments was the export revenue, first the "energy revenue" plans could be challenged. These calculations apparently are based on a steady, constant, and equal growth of costs and revenues. The "06" document draws the attention to this constant growth rate at all elements of the calculations. However, economic logic shows that if the revenue flow is shifted "further" from the current period, net present value of the calculation can be decreased strongly, especially at relatively high discount rate. In the same time, cost elements can be increased in the shorter period. It can be stated that it is not the discount rate to which the original calculations are most sensitive, but the time distribution of costs and revenues. An argument for the "discount rate sensitivity" may take us to very dangerous land: it is shown (in the table below, too) that lowering the discount rate would decrease the loss, therefore, increase the value of the expected efficiency. Between 1 and 2 percent the project is zero. Then, it is hard to argue that at that time the "discount rate was too high", because lowering it would give "better" results. On the other hand, arguing that "the discount rate was too low" can be challenged, because in the 1980s the real interest rate (primarily due to the lower inflation rate) was definitely higher than it is now. It can be concluded, therefore, that the 1988/89 discount rate use can hardly be challenged. Nevertheless, the discount rate sensitivity of any "net present value" calculation is doubtless. But in this case a slight decrease of the applied rate would have been more logical, and this would have been a more "efficient" result. The real sensitivity lies much more in the applied absolute cost and revenue data, and in their time distribution. The real sensitivity lies much more in the applied absolute cost and revenue data, and in their time distribution.