ON THE ECOLOGICAL-ENVIRONMENTAL EFFECTS OF THE GABCIKOVO(BŐS) BARRAGE SYSTEM

Summary of the Ecological Risk Assessment based on the research reports, standpoints and opinions of the Hungarian Academy of Sciences

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Introduction

During the long-lasting period of planning the Gabcikovo- Nagymaros Barrage System, fundamental research and investigations were neglected and not carried out. The program and plans were prepared without the invitation and participation of institutions that would have been competent in the problems to be solved.

The construction of the Gabcikovo-Nagymaros Barrage System approaching the stage when the natural environment was to undergo profound changes, several prognostic schemes and environmental risk assessments were compiled by the experts of such questions, although official demand had never been expressed to this goal before the end of the 80's. These schemes were sufficiently precise to show the dimensions of the natural resources involved, and called attention to the serious danger caused by the construction. However, presentation of the risks in their exact form was not possible due to the lack of investigations that would have been fundamental during the planning and early constructions.

In the recent past, admittedly with a long time lost, the Hungarian Party started the assessment of environmental conditions and the solution of some modelling problems along the common Hungarian - Czech and Slovak section of the Danube. Thus, the most urgent tasks of environment protection and water management will have enough ground to be planned on.

Three times since the suspension of construction, the Hungarian Party handed over to his partner summaries prepared by institutions investigating the environmental risks of the Gabcikovo-Nagymaros Barrage System. Hungary urged joint research and investigations. On the other hand, the Czech and Slovak Party has never presented results that would prove the risks to be under a tolerable level.

It is regrettable that the radical differences of viewpoints apparent in official opinions of the two parties still prevent the technical-scientific discussions from being started. Without this, the problems of the region are not likely to find solution.

1. Geological and geophysical risks

1.1. From the point of view of geology, the greatest risk is the lack of detailed knowledge of the area: in such circumstances a number of preparatory and planning tasks (environmental impact assessment, technical planning) cannot reach grounded results. Safe prognosis can be made only on the basis of systematic studies revealing the background geological conditions.

1.2. The planning of the Danube dams was not preceded by a detailed geological survey of the region. A serious mistake is that there was no structure-exploring deep drilling in the impact area of the dams. The insufficiencies of planning are well demonstrated by the fact that the contractors did not even have the necessary permit of the geological authorities.

1.3. A further problem is that the research results obtained separately in Hungary and Czech and Slovak Republic have never been integrated. For example, the so-called Gabcikovo fault line discovered in Slovak territory has not been traced further in Hungary. This fault was the reason why the site of the Gabcikovo dam was changed in the early 70's, although by not more than 600 m with respect to the original plan. Thus, as is admitted by a Slovak expertise, this dam has been built in the neighbourhood of a geologically young fault.

1.4. The most important element of the deep structure in the impact area of the Gabcikovo dam is the Rába line, the border of the Alpine and Trans-danubian tectonic units. Its position is highly uncertain, at present it can be traced in two alternative variants. Structural exploration by means of drillings in the young sediment has not been carried out; satellite photos which may be evaluated in numerous possible ways do not allow to form a unanimous and profound opinion. In the structure of the neogene sediments listric and other fault planes can be found by the analysis of seismic profiles. Consequently, clear structural view cannot be constructed yet.

1.5. Another set of problems concerns the seismology of the area of the Gabcikovo-Nagymaros Barrage System. The seismicity values of the Joint Agreed Plan cannot be accepted; the seismicity problem cannot be answered with a reliability required by international norms since the necessary studies are missing. The seriousness of the problem is shown by the fact that the expected intensity estimated for the Dunakiliti area from historic quakes is 8.7-9.0 MSK at the usual security threshold, while the original plans were prepared by assuming 6.0 MCS.

1.6. The sizing of the embankment is an especially grave problem among the uncertainties of planning, owing again to insufficiencies of prior investigations. The weakest point of the Dunakiliti reservoir is the embankment: it is the largest structure regarding its volume but it is also the most heterogeneous one in its size, structural constitution, material and quality. One of the most important pieces of information obtained from the geophysical analysis of the Dunakiliti reservoir on the Hungarian side (1991) is that high-resistivity gravelly structures - ancient riverbeds - have been found beneath the embankment at several places. This was not explored earlier. Examples from the past show that this structure can lead to a breach in the embankment and, subsequently, to serious flood. The stability of certain parts of the embankment cannot be considered safe against earthquakes that are likely here. The same applies to the stability of the banks higher than 7 m, as they are not sufficiently safe against sliding. On the contact surface between the base and the body of the embankment, soil liquefaction can occur.

Security tests along the Dunakiliti reservoir show that the safety characteristics of the embankment do not fit the international standard norms. The risk level taken into consideration in the plans applies only to common buildings where environmental effects can be excluded.

2. Effects influencing the ground water

The environmental and ecological consequences of the Gabcikovo dam will follow from the hydrological and hydraulic changes and from the pollution of water. These phenomena will accumulate and amplify each other, their interaction may give rise to further effects.

For the prediction of the resulting damage it is to be taken into account that the self-inducing effect of the changing environmental conditions will manifest itself slowly, and partly in a hidden manner, at least in some aspects of the changing ecological system. Thus the conclusions drawn from short-period model studies may be highly uncertain and unrealistic.

There is a group of damages and drawbacks that are proven unambiguously, further ones supported by field data but not fully verified, and a last group which has not been studied yet but is very probable.

2.1. **It is right in the area of the Danube affected by the Gabcikovo-Nagymaros Barrage System where the most important drinking water reserves of both Hungary and Czech and Slovak Republic can be found. 45% of Hungary's drinking water supply comes from percolated water in the area of the Gabcikovo-Nagymaros Barrage System, providing e.g. Budapest with drinking and industrial water for more than a century. A similar system serves the water supply of Bratislava. The relevant part of percolation and natural filtering occurs in the uppermost layer of the riverbed, some centimetres thick. It is therefore highly necessary to maintain the conditions that preserve the original state of this biologically active layer providing physico-chemical filtering.**

2.2. **It is again the filtering capacity of the riverbed that determines the quantity and quality of the water stored in the alluvial cone of Csallóköz-Szigetköz, a gravel layer several hundred metres thick. Fortunately enough this water reserve, which is permanently refreshed from the Danube, has not been disturbed in the course of the construction activities related to the Gabcikovo-Nagymaros Barrage System. Thus both countries have riverbeds of great length, Hungary about 40 km and Slovakia more than 70 km, that can be used later for water supply, according to detailed water quality and hydrogeochemical analyses. On the Hungarian side, this means a capacity**

of 1 million m^3/day permanent drinking water supply - the average need of the Hungarian capital -, while in Slovakia this amounts to 2 million m3/day.

2.3. As a result of the operation of the barrage, fundamental changes will occur in the area of the Dunakiliti reservoir. The basic problem will be caused by the deposition of polluted silt, with its anaerobic dynamics, iron and manganese mobilization, and infiltration of toxic organic materials. This silt would mean a permanent source of viral contamination.

2.4. Because of the specific hydrogeological situation of Szigetköz, the toxic materials will pollute the ground water reserves within some tens of years. Moreover, since periodic dredging is planned for the removal of accumulating silt, this will not only be harmful to the quality of the surface water but, by destroying the filter layer, it will allow organic micropollutants and microbes to reach the ground water level. The channel system, planned to counterbalance the deepening water table (ground water level) along the Old-Danube under the Dunakiliti dam, will result in the pollution and loss of stored water depending on the quality of the inlet water and the state of the colmatated river branches. The degree of this pollution and loss can be estimated only very roughly, due to the lack of detailed long-period hydrological and water quality studies.

To preserve the role of the riverbed in filtering and decomposing the toxic organic matter, the present dynamics of the Danube should be maintained. Without this, the required oxygen supply, the self-purifying capacity of the Danube water and the regular renewal of the filtering bedsurface cannot be guaranteed.

It is to be noted that the conclusions of the Hungarian experts concerning ground water are identical to those found in the February 1990 report of the Slovak scientists. As to the missing investigations, similar conclusions were obtained by the Hydroquebec Company: this Canadian firm was requested by the Slovak government to form an opinion in the fall of 1990.

The water table will rise around the reservoir owing to the damming-up and to the change in the riverbed, while it will sink around the Old-Danube and the power canal due to the decrease of natural infiltration from the main branch.

2.5. Where the water table is lowered, mineralization of the vegetation remains is accelerated; the organic material content of the soil is diminished; deterioration of the soil structure and the eluviation of nutrients grows

dangerous. Where the operation of the barrage lowers the ground water level from the fine surface layer down to the gravel, capillary water supply of the root zone is stopped. As a result, the crop of cultivated plants is reduced considerably and becomes uncertain; drought-resistance is weakened; water supply of the forests in the inundation area changes unfavourably; now contiguous ecosystems become isolated patches with a reduced production of organic material. (As is testified by the Upper-Rhine dams, a 50 cm lowering of the water table results in a 50% loss of crop.)

2.6. Where the water table is raised, air ventilation of the soil is diminished and anaerobic processes become predominant; there is a growing danger of inland waters; secondary sodification can occur in areas with bad natural drainage conditions, especially on the left bank of the Danube, east of the mouth of the river Vág. (Several years after damming up the river Tisza at the Tisza II barrage in Hungary, the surrounding agricultural area became a marshland and a dramatic loss of crop resulted on many thousands of hectares. This process could not be counterbalanced, therefore the gold crown value of these lands was halved by the authorities.)

3. Effects on the surface waters

3.1. **The Dunakiliti reservoir, after being filled up, will be the scene of unambiguous water quality deterioration. The reproduction of phytoplankton, which plays a key role in the material exchange of the Danube water, is now hindered by two factors: the flow speed and the quantity of light. (The nutrient surplus is already considerable.) As a consequence of the damming-up, the water speed in the reservoir will slow down, stagnant bays will form, the sedimentation rate will shoot up (the deposition of 3-5 million m^3/year suspended material is estimated) and the ground water surface will rise due to the initial infiltration surplus. Since the flow speed will slow down and the water transparency will increase, the efficiency of the factors hindering the reproduction of algae will diminish: thus eutrophication is inevitable. The organic matter production of algae is already 100 tons a day in dry weight along the Rajka-Nagymaros river section. This amount will be multiplied as soon as the reservoir is put into operation, and the consequences of the decay of this algal biomass will afflict the Hungarian section of the Danube above all.**

3.2. **The soil humidity of the inundation areas along the abandoned riverbed of the Danube will decrease, the ground water surface will sink and arborescent vegetation will spread over the dry riverbed.**

3.3. **The sediments of the reservoir, an expected quantity of 3-5 million m^3/year as mentioned above, will contain industrial, agricultural and communal pollutants (viral and bacterial contamination, toxic organic matter, heavy metals). This implies deterioration of water quality and, in addition, serious reposition problems if the removal of sediments, costly for itself, seems necessary. Hygienic and bacteriologic indices show that the water is polluted already and this situation may worsen if the reservoir is filled up. The human and non-human biological effects of the bituminous insulation that has been laid down in some places on the reservoir embankment are still uncleared. Similar asphalt insulation has been built in the embankment all along the 17 km long power canal, again without clear knowledge of its effect on water quality. Fishing utilization of the power canal may reach only a small fraction of the one of the Old-Danube, present main branch of the river. The consequences of the negative effects discussed above are likely to be felt down the river for, possibly, 150-200**

km (i.e. also at Budapest) in the best part of the year. A significant and prolonged increase of the organic matter load, decay of the self-clarifying capacity, possible deterioration of the oxygen circulation and hygienic indices are factors that can cause grave and costly damages in the drinking and industrial water supply.

4. Ecological and genetical problems

From the point of view of biology, the affected region constitutes an integral system. The construction of the Gabcikovo- Nagymaros Barrage System caused damage to two areas of outstanding natural value: Szigetköz and the bend of the Danube (Dunakanyar). Although the devastation of the natural resources and that of the landscape is significant, the damage is mostly reparable.

4.1. **The biocenoses of Szigetköz still occupy a considerable area in natural or near-natural conditions, especially in the inundation zone. These ecosystems have adapted themselves to the seasonal dynamics of water. They follow gradually the constant changes in the Szigetköz branch system (cenological succession). In the case of forest populations this process is considerably slower and can be measured in terms of centuries. The answer to quick and drastic changes is degradation and decay. For the regeneration of forests living in near-natural conditions, centuries would be needed at the very best.**

4.2. **The forests of Szigetköz are Hungary's highest yield growing stock, the two-thirds of which is constituted by poplars spreading everywhere from the 1930's on (30 m^3/hectare/year). This population utilizes the fluctuation of low and high water optimally. On account of the river regulation, the productivity of these populations has been diminished significantly. By further lowering of the water table, these excellent wooded areas will be lost and only forests of much lower productivity could be replanted later.**

4.3. **Szigetköz is especially rich in species, only of flowering plants 60 protected ones can be found in this area. A considerable part of the flowerless plants and microorganisms is unknown so far. In the past few years only, 11 new species of fungi - unknown in other parts of the country - have been discovered here. The fauna of Szigetköz is similarly rich. 63 fish species of the 80 ones living in Hungary can be documented in the area. Several groups of animals have not been documented fully until now. Each year, there are a number of new species found. All of them are of national value: their preservation for the future generations is a moral obligation.**

4.4. It is evident from the consequences of the construction activities carried out so far that the extensive destruction of biological resources cannot be evaded even by the most careful operation of the Gabcikovo barrage. The indirect effects are far more dangerous than the direct ones. Changes like that of the water table, disappearance of the seasonal fluctuation, modification of the oxygen supply of water, all have their effect on species organized into populations with redoubled intensity. New conditions of competition, predation and other interactions in the new environment lead to the local extinction of species or their degradation. The probability of survival after any significant environmental change depends on the scope of genetic diversity. Only numerous, genetically diverse populations can have a chance to accommodation.

4.5. It is more worrying that the disappearance of genetic diversity and a consequent lack of adaptability may cause further extinction, leading finally to a severe degradation of the region and an 80-90 % decrease in the number of species.

Part of the described ecological and environmental risks are proven unambiguously, further ones are supported by analogous experience abroad and at home: therefore they can be predicted reliably. The Czech and Slovak Party has, up to now, not presented results demonstrating that these serious dangers could be reduced to a tolerable degree by posterior technical measures.