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TASKS AND POSSIBILITIES OF MODERNIZATION IN REGIONAL WATER MANAGEMENT

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Abstract

Regional water management is an infrastructural activity so on a social level it does not belong to the category of aim but rather to that of means. The crucially important task is to create water management conditions suitable for the different demands of area use and utilization.

As regards the system of conditions, three factors should be taken into account:

- natural conditions/resources,
- the demands of society and
- ecological requirements.

Beyond this, these inner relations of water management as well as the effect mechanism of the relations between water management and other sectors should be analysed. It is on the basis of this analysis that we should determine the water management requirements belonging to the different forms of area use, on the one hand, and the technical-economic-organizational form and optimum of operations, on the other.

Keywords: regional water management.

1. Summary of Tasks and Possibilities

Regional water management is an infrastructural activity so on a social level it does not belong to the category of aim but rather to that of means. The crucially important task is to create water management conditions suitable for the different demands of area use and utilization.

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Beyond this, these inner relations of water management as well as the effect mechanism of the relations between water management and other sectors should be analysed. It is on the basis of this analysis that we should determine the water management requirements belonging to the different forms of area use, on the one hand, and the technical-economic-organizational form and optimum of operations, on the other.

The Task of Water Management:

- to create quantitatively and qualitatively suitable water conditions including safe flood control for *the operation and development of municipalities*
- and for *the processes and development of the economy.*

In the scope of this attention must be paid to:

- creating a healthy human environment
- the protection of environment and natural resources
- assuring the security of life and property
- changing and forming landscape in an aesthetic way.

The regional water management sector is responsible for the coordination and harmonizing of the natural conditions, on the one hand, and *social and area use demands,* on the other, which latter *change* in both space and time, and it can achieve this aim by optimally constructing and operating water works.

In order to fulfil this task on a good level it is therefore necessary to develop, gather a complete knowledge and analyse the effects of

- the laws of natural conditions and their changes,
- the trends of social and economic conditions and the demands for area use created by them,
- the economic and ecological requirements of the micro- and mesoenvironment, the region or the subregion and
- the means for regulation and intervention of the regional water management sector.

2. Examination of the Existing Inland Water Systems

The water carrying elements of the existing traditional inland water systems have been built out to achieve approximately the same level of safety. In accordance with this, they create 'quasi-regulated' conditions harmonizing with their actual hydraulic relations.

In every case the order of dewatering corresponds to the inner hydraulic status of the system and the outlet conditions of the catchment area. With such systems the direction of operational process control is always from the main elements of the system towards the elements of hierarchically lower system status. Emergency reservoirs may be put in between system elements of different capacity.

The reservoirs appointed and partially constructed are generally gravity operated, therefore they are not suitable for damage prevention, only for the mitigation of damages at the utmost.

When actual water discharge surpasses the calibration values, systems can only be handled in an emergency operational mode with internal water protectional interventions involving considerable internal water damage.

The desired head works capacity of the system can be primarily achieved by increasing the capacity of pump stations, by adding further sections to the collecting mains and by lowering the bottom and the standard power water levels.

Internal water damage is likely to take place in the areas within the diked marsh. Apparently, most frequent floodings are likely to develop in the deepest areas, therefore their dewatering will involve the highest specific costs. (See *Fig. 1*).

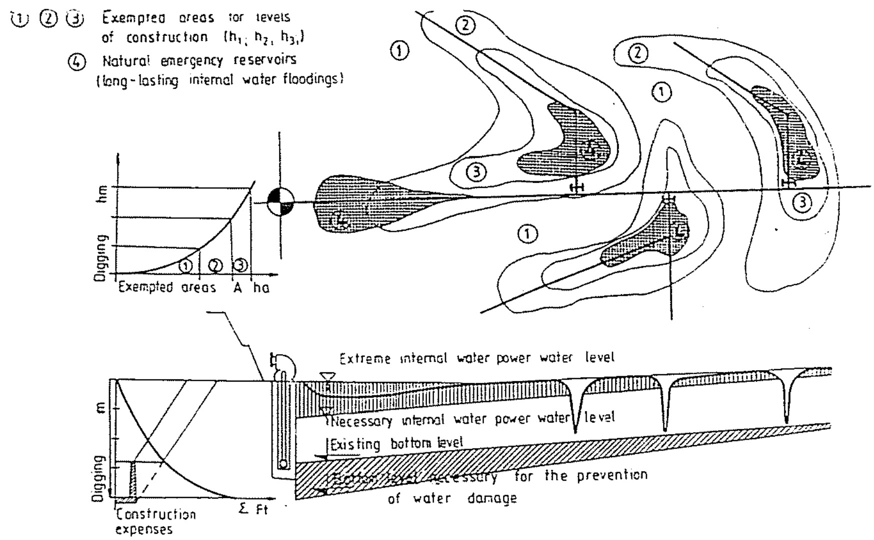

Fig. 1. Traditionally built-out internal water system

Furthermore, such kind of inland drainage also involves that for the drainage of a minimum A_1 area a very considerable amount of concentrated capital Th_1 is required (See *Fig. 2*) and it is desirable that work should be done in this order: first on the state, then on the associational (between water works) and then on the individual water works level.

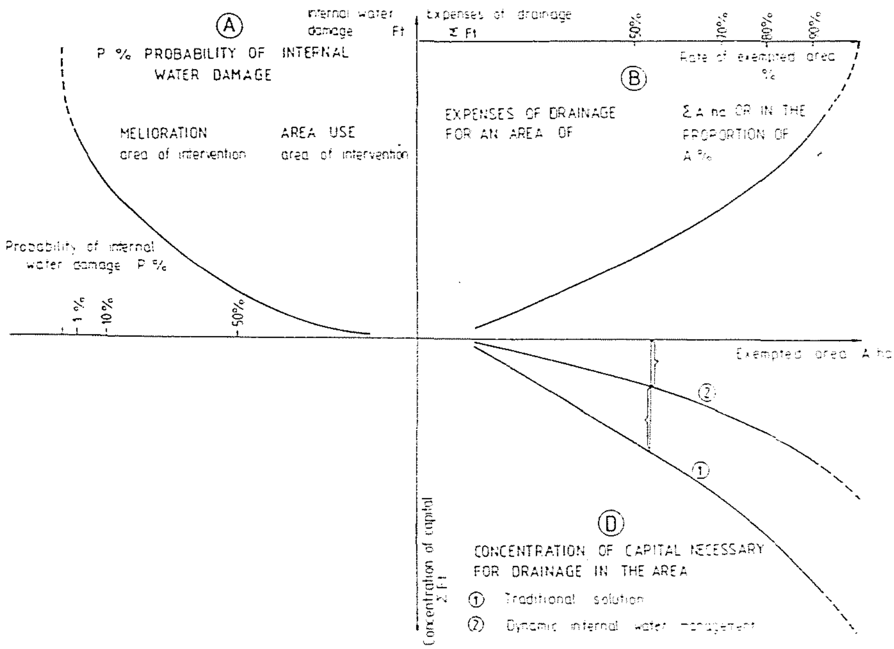

Fig. 2. Connections of internal water damage, exempted areas and the concentration of capital

'Dynamic' Operational Mode of Internal Water Systems

Traditional internal water regulations link taking operational measures to data from a few gauging stations and water meters. A considerable number of these interventions do not strive to prevent damage but to put an end to the already existing harmful conditions and to mitigate damage.

If we want to prevent damage, we should technically modernize the operation and in close connection with it the water system.

In order to modernize operational control we have developed the software package called *Computerized Operational Control of Internal Water Systems (BSZÜ)* at the Department of Water Management of the Budapest Technical University with the cooperation of the Department of Civil Engineering Technology of the Gödöllő University of Agriculture.

The Computerized and Space Informatics System Consists of Four Units:

a) data of the internal water systems and internal water catchment areas,
b) processing and handling of data entered into the system and listed,
c) processing of the rainwater data most important for internal water conditions,
d) a mathematical model of the optimal draining of internal water.

In order that the operational modifications should ensure the sufficient efficiency in preventing damage, some technical modernization of internal water systems is also required. A possible — but by no means the only possible — solution for this is presented in *Fig. 3.*

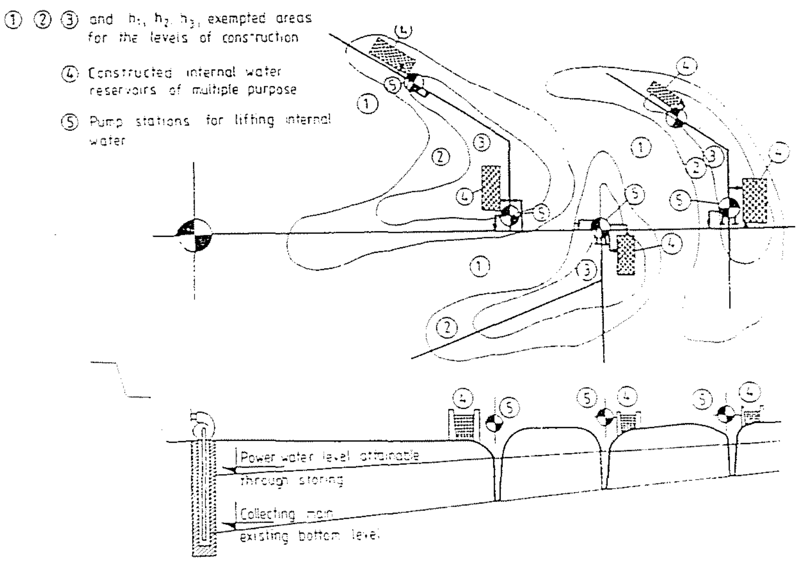

Fig. 3. Internal water system with dynamic operational control

This operational mode is not based on the hierarchy of the internal water system but rather on that of the internal water catchment area. In accordance with this we wish to ensure the regulated dewatering of the tablet and the block which should happen in accordance with the demanded time schedule.

3. Determining the Scope and Methods of Construction for Internal Water Systems

In internal water systems the periods of drought and water abundance appear alternating with each other. If we plot the probable levels of *rainfall (C)* and potential *evapotranspiration* (ETp) (See *Fig. 4*), we can see how long in a particular region arid and water abundant periods are and what their proportion is.

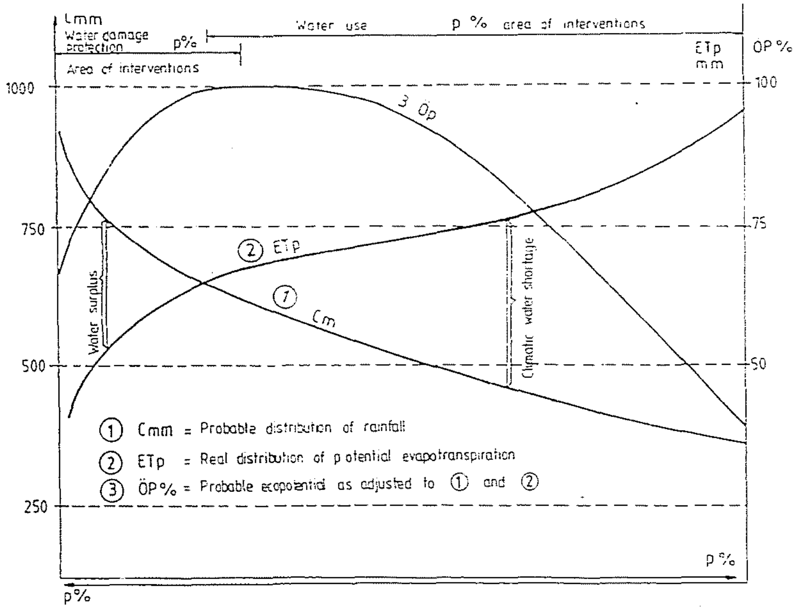

Fig. 4. Probable levels of rainfall (C), potential evapotranspiration (ETp) and technical agroecopotential (AÖp)

It is also clear from the figure that investments in water damage protection prove profitable in the wet period which constitutes 25–30% of all the time while investments in irrigation — in the dry or droughty period make up for 60–65% of the whole.

It means that the necessary amount of profit ensuring returns and efficiency should be produced either during the water abundant or arid subperiods. Internal water works are out of operation in the arid subperiods, they are dead capital during that time. Than is why it is important to reduce the amount of capital tied up for water regulation purposes to the lowest possible level.

Possibilities of agricultural use for areas in the submarshes of internal water systems are mutually determined by soil and climate conditions. Substituting the 'technical' *Agroecopotential (AÖp)* for soil fertility, it changes as a function of the climatic factors — rainfall and evapotranspiration — as is presented in *Fig. 4*. Here *AÖp* expresses all those local characteristics which have a considerable effect on fertility because of the soil and groundwater conditions, the geographical location etc. of microregions within the boundaries of a region with the same climate.

As a theoretical approach it is acceptable that the probable level of rain precipitation is proportional to the probable amount of water damage (*water damage* $p\% = f(C; p\%)$, whereas rain shortage is proportional to the amount of damage caused by drought or aridity (*damage caused by aridity* $= f(C - ETp); p\%)$. These different kinds of damage may appear together within the same years (e. g. summer drought, internal water damage in autumn or winter drought, internal water damage in summer, etc.) Regarding the whole period examined it is dependent on its climatic characteristics that the probable distribution and amounts of damage caused by internal water and by aridity can be projected.

In the water abundant period the probable amount of damage which can be prevented (in the present case the loss in production) is the difference between the technical agroecopotential and the actual yields. Assessing the possible and actual status in this way, we may determine the amount of preventable damage and in accordance with what was said above the amount of expenses necessary for damage protection which also gives information about the rentability of the interventions.

Fig. 5 compares the amount of drainage expenses during a given period in a particular internal water system with the amount of preventable internal water damage.

Taking the above into account we have suggested using a computer algorithm when examining and determining the scope and method of construction for internal water systems. We should like to realize these through creating a coherent system of the methods and processes available or through using them systematically also taking current research into account.

The aim of development is the *optimized determining of the dynamic levels of demand* (interventions) *of melioration and drainage* on the basis of the analysis of

- the natural and social characteristics,
- the water management and agricultural utilization relations and
- the economic and area use potentials of the *diked marshes.*

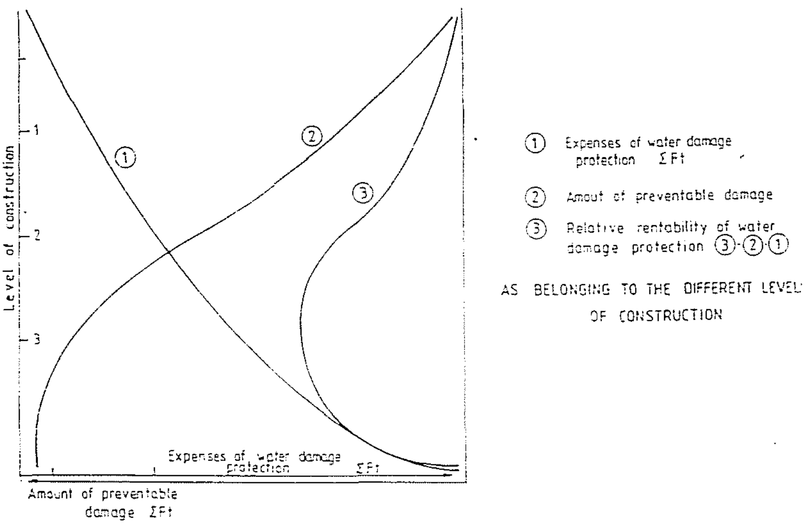

Fig. 5. The expenses of drainage and the amount of preventable damage

In the course of this the aim is to work out a method by which the internal water system can be made suitable for:

- meeting drainage demands belonging to the intensification levels of agriculture,
- the reasonable control and regional optimization of the level of construction and drainage and melioration expenses,
- changing area use as demanded, besides keeping strategic aims in mind making a good use of boom in the market,
- constructing the main works and the parts between works of the system in a way that fits economic strategy, probably with a changing scope of construction in time,
- enhancing the flexibility of the diversion of water,
- the prevention of water damage and the introduction of the control of the water supply in the soil through modifications in operational control,
- assuring the protection from water damage of municipal and built-in areas,
- the taking into account and protection of natural resources, the programming of environmental protection tasks, the analysing of the effects and the minimization of adverse effects.

We have suggested carrying out the examination on the basis of the following main (menu) points:

3.1 Description of the natural characteristics of the internal water catchment area.

3.2 Taking social and economic conditions into account.

3.3 Connections between the constructional level of internal water systems and damage caused by internal water.

3.4 Requirements for internal water management determined by the level of area use.

3.5 *Possible methods of constructing internal water systems and their connections with other systems:*

The examination covers the hierarchical relations of existing systems and systems after development.

We are going to use algorithms when developing alternatives for the various forms of construction, e. g.

- gravity systems,
- systems with intermediate lift-over,
- systems with intermediate lift-over and inner storing, etc. and also for the possible track of canals and the variations of their hydraulic capacity as defined by the above.

We are going to determine the levels and scopes of construction characterized by different area use belonging to the particular form of construction and also the amount of work and expenses. We can determine the rentability of the particular alternatives after comparing these factors with the amount of preventable damage. (See *Figs. 3* and *5*).

3.6 *Environmental effects and connections of the different construction systems*

We are going to take the natural, ecological and environmental resources to be found in the area of the inland water system into account.

We will determine the environmental — water management, soil science, area use and ecological effects we wish to achieve through inland drainage and melioration.

We will decide on:

- the surface and area formations we wish to create by regional planning,
- ecological, natural and environmental resources to be protected,
- the area of flooded territory to be preserved and the area of temporary reservoirs,

- the demand for and methods of operational control and technical solutions which are necessary for the protection of resources and are different from what is usual.

3.7 *Comparison of the various forms of construction, technical and economic decision-making*

Selecting from among the alternatives the one which may assure the highest level of economic efficiency and comes nearest to the regional optimum. From such an examination and development of systems we expect that

- it will give the exact amount of preventable damage for the particular forms of construction,
- the efficiency of interventions will be considerably improved based on the data of differentiated internal water sensitivity, internal water damage in fractional areas, the agroecopotential characteristic of microregions and the expenses of the different levels of construction which are gained through the examination of the parts of diked marshes,
- with the introduction of dynamic internal water construction and system operation it will be possible
    - to reduce the amount of and demand for concentration of capital necessary for development,
    - to realize the development in question independent of the development of main and intermediary works,
    - to achieve the economic optimum in the regions and microregions through development,
    - to assure the order of dewatering in accordance with the demands of the 'actual' area use.

During the solution of water damage prevention tasks more and more attention should be paid to the concrete water management demands of area use as well as to the economic burden-bearing capacity of the areas in question. The analysis of the economic, water management and ecological effects of interventions may be carried out, e. g. in accordance with what was said above.

The use of this method will make it possible to use technical solutions approaching the economic optimum or being proportional to the risk which can be taken. At the same time it is also possible to get information about the probable amounts of damage caused by the postponement of interventions.

With the use of the development and operation solutions proposed it is possible to reduce the demand for the concentration of capital, to increase the degree of freedom of the interventions and to improve the level of regulation and the ability to prevent damage within the systems. On the basis of all these the integrated efficiency of the interventions can be improved.

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