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APPLICATION OF THE CARTOGRAPHIC METHOD IN THE STUDY AND RATIONAL USE OF WATER RESOURCES

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Ten years ago the May Plenum of the CPSU Central Committee set an objective to create big regions of guaranteed grain production in the dry zones of our country by rapidly developing irrigation practices in the Volga region, Southern parts of the Ukraine, North Caucasus and in other parts of the country.

Reclamation construction was developing at a rapid pace. Thus, from 1965 to 1974 13 million hectares of land were reclaimed, that is twice as much as in the previous ten years.

To supply water to industry, agriculture and population a number of canals of different length such as the Karakum canal - 1400 km, the Irtysh-Karaganda - 450 km, the North--Crimean canal - 403 km have been completed or still under construction.

In 1976-80 it is planned to irrigate 5.3 mln.hectares of land and 44 mln. hectares of pastures and drain 6.5 mln. hectares of land. During the same period of time reconstruction of irrigation systems will be done on 1.5 mln. hectares of land and that of drainage systems on 1.5 mln.hectares as well. Water structures of the formerly irrigated pastures are to be improved.

Tremendous efforts will be employed to intensify agricultural production in the non-black soil belt of the Russian Federation. 35 billion roubles allocated by the State will go to reclamation undertakings, construction of roads and localities, chemisation of lands.

At the present state of development any plan for rational use of water resources has to meet severe requirements. Such plans must take into account the demands of all water consumers not only in the coming five-year period, but in the far future as well.

The USSR Ministry for Land Reclamation and Water Management is responsible for coordination of problems of rational use of water between branches of national economy.

The USSR's water resources are distributed rather unevenly over its territory. The average annual renewable water resources of all rivers amount to 4714km^3. If you distribute them on the ocean basin principle then you can have the following picture: the North Arctic Basin has 52% from the total area and it gets 64% of all water resources. For the Pasific Ocean Basin these figures are correspondingly 15% and 20%. For the Atlantic this ratio is 8% and 7%. And for the Aral-Caspian Depression it is 25% and 9%.

One can see from this comparison that the country's main agricultural regions situated in the basins of the Atlantic Ocean and Aral-Caspian Depression get only 16% of all rivers' runoff.

That's why lots of work are done in our country to divert water from one basin to another. We are also faced with the problem of huge interbasin transfer of water from North Arctic Basin to the Aral-Caspian Depression.

Effective study and elaboration of methods for rational use of water resources, as well as planning of water projects cannot be successfully done without extensive use of the cartographic method in hydrological investigations based on a deep analysis of different cartographic documents reflecting most diverse hydrographical data, landscape features and economic activities of the man.

This statement is very true because cartographic documents have a characteristic possibility of reflecting spatial disposition, combination and intercommunication of natural and social phenomena, as well as their changes with time. It is especially important in the study of hydrometeorological phenomena characterized by high dynamics in both time and space.

Analysis of various nature maps provides necessary hydrographical and physico-geographical characteristics of the surface where water resources are formed. These maps can also help to determine such factors as character and geography of water units, quantity and quality of water resources, etc.

Hydrological maps have a special value. They reflect many peculiarities of water resources and because of that deserve to be studied very carefully when solving numerous scientific and water problems.

The most important maps are those that carry information on average annual runoff, minimum and maximum runoff, runoff discharge of rivers, chemical properties of waters, thermal and ice regime, etc.

Maps can be of great practical value in the study of erosion processes. The central black soil regions and others affected by water erosion have made maps of density and depth of ravines. Further analysis and comparison of these maps with other special maps give us enough information about landscape, precipitation, number of storms, intensity of snowmelt, degree of ploughing up and other natural factors that influence the development of ravines. All this is necessary to know to predict danger of erosion and work out measures to control it.

Physico-geographical maps such as landscape maps, geological, hydrological, geomorphological, on quaternary deposits, soil, vegetation, swamps and others much be considered when problems of scientific argumentation, planning and design of water and reclamation projects are to be solved. When planning comprehensive water development projects in this or that basin the problem of mapping of underground water reserves as part of the total water balance becomes very important.

National economy's demands call for a study of regional underground water reserves. That is why such maps are used to identify the role of underground waters in the total water balance of this or that area, determine possibilities of their economic utilization for various purposes as local, but as well as an additional source of water supply, find right locations for planned industrial, public and agricultural projects, with account to available water resources. They are also helpful in determining correct directions and volumes of prospecting works for water when planning water projects.

To study regional underground water reserves with a view to satisfy the demands of national economy one has to assess

separately their static and dynamic reserves (to determine the role of underground waters in the total water balance of a given territory and the quantity of underground water that can be taken for various economic needs.)

Maps of underground water reserves differ in scale. Thus, every map is assigned a role to play in solving different problems. Maps of 1:25000 in scale and bigger are made for substantiation of an engineering project and working drawings of undertakings that would call for use of underground water for this or that particular purpose. These maps are purely specialized as they are drawn up on the basis of detailed reconnaissance of underground water of a given territory. Detailed or large-scale maps such as 1:50000 and 1:100000 are intended for substantiation of underground water use at the elaboration stage of an engineering project. General purpose maps (medium scale) 1:1000000, 1:500000 and 1:200000 are intended for substantiation of utilization and conservation of underground water at the elaboration stage of a scheme.

Survey small-scale maps of 1:2500000 and smaller contain mainly data necessary for evaluation of distribution of underground water reserves on large areas.

In planning an important role is played by social-geographical maps: population, industry, agriculture, land resources, transportation, etc.

The mentioned above cartographic documents are very important inspite of their small-scale size and survey character. They provide valuable information on general physico--geographical and socio-economical characteristics of a region under study or in the process of development.

This is especially of vital importance in planning and designing large water projects. That's why all these maps must meet the following requirements:

- vividly and exactly enough in accordance with their scales reflect drawn phenomena, units and degree of their study
- provide a general assessment of natural conditions and approximate evaluation of quantity and quality of water and other natural resources for concrete economic and geographical regions

- indicate preliminary needs in certain natural resources to meet the demands of population, industry and agriculture.

- enable to make correct scientific conclusions about interdependence and interaction between elements and phenomena of nature and development in conformity with natural laws.

- provide prediction of changes of natural conditions under the influence of the economic activities of the man.

All special maps carrying information on separate phenomena and units of nature must be comparable from the general geographic point of view. Like natural phenomena they should be coordinated with each other and be also interdependent. This can be acheved by unity of principles in working out geographical bases for all nature maps and coordination of methodologies in mapping. The unity of plan views and seals of maps as well as their main content can be followed quite easily by using basis maps (1:2500000 and 1:5000000) edited by the main division on geodesy and cartography within the USSR Council of Ministers. The second condition concerning coordination of methodologies is much more difficult to follow.

However, in recent years GUGK sponsored a number of All-Union Conferences on mapping that helped to improve considerably the process of coordination of methodologies.

At present the design and research institutes of the USSR Ministry for Land Reclamation and Water Management worked out "Schemes of comprehensive use of water and related land resources" for agricultural regions. These schemes contain much information on water resources. It is necessary to put all this information together and to use it for elaboration of water economy atlases that would reflect all problems of comprehensive use of water resources in national economy at its present situation and in the future.

It would be reasonable that such atlases are developed by GUGK which is equipped with numerous maps, and the initial data have to be supplied by the design and research institutes of the USSR Ministry for Land Reclamation and Water Management.

Topographic maps of different scales are the main and, in fact, only means used in hydrographical studies of water

units and design water undertakings. Only topographic large--scale maps (1:10000 and 1:100000) can provide you with reliable data on hydrographical characteristics of rivers, lakes, reservoirs, ponds and their watershed basins. The importance of a water unit and its watershed, as well as the purpose of hydrographical characteristics to be defined are determining factors in the choice of map's scale.

A detailed analysis of large scale topographic maps enables us to obtain data on morphometrical characteristics of the river-bed and flood lands (dimensions and curvature of meanders, coefficients of tortuosity, river-bed and slope gradient, etc.)In comparing maps of different times and aerial photoes one can establish the dynamics of river-bed processes and also determine the magnitude and speed of cutting into the slopes, slope erosion, deformation of the river bed and the delta, erosion and washing out of the shores of artificial and natural reservoirs in connection with hydrotechnical construction.

Cartography comes also to help when studying factors determining runoff of river basins. Comparison of various maps with application of mathematical statistics is used to determine the dependence of runoff distribution on precipitation, absolute altitides, stream flow gradient and other landscape factors.

The right choice of topogrphic maps is a decisive factor in the accuracy of hydrographical characteristics. The same is true, when you design and construct a water project.

As landscape features and especially water units due to their high dynamic characteristics are subject to relatively fast changes, topographic maps must be up-to-date. In other words they must reflect the actual state of things in the country.

To solve hydrological, hydrographical and water economy problems one should use only the most recent topographic maps. Use of out-of-date maps is inadmissible as it can lead to big mistakes in hydrographical evaluation and planning of different projects.

It is necessary to stress that a wide use of cartographic documents of various scales and purposes does not fully substitute the cartographic method of investigations. It is only one part of this method which happens to be one of the most passive ones. Unfortunately, very often application of the cartographic method does not go any further than that. Nevertheless, this method also means elaboration of derivative maps: appraisal, resource, predictive, district division, etc.

In solving water problems for instance, wide use could find such maps as:

1. Maps of consumption of water resources showing water consuming centers and industries on the territory, volumes of water consumption, etc.

2. Maps of conservation of water resources with indication of various measures to conserve water, planned or carried out in a given region, their results, as well as degree of pollution of water units and measures to clean them, and other data.

3. Maps on water reserves by years with different water availability specifying their volume, location and possibilities for redistribution over the territory.

4. Maps indicating flood-affected regions, showing the limits of different disaster zones subject to inundation at critical levels of high water in rivers and reservoirs, types of flood control measures and other information.

5. Maps of local runoff.

At present methods of aerial photography are becoming very common in hydrological investigations . Other methods have been developed to determine the depths, flow velocity in rivers directions and velocities of upper flows in reservoirs, as well as water discharge of rivers.

Urgent aerial photography is undoubtedly an irreplaceable source of information in studying disastrous floods and ordinary inundations and it is especially important for mapping them.

Periodical air photography gives the investigators information of great value about the dynamics of hydrological processes and phenomena such as, for example, intensity of snowmelt, character of glacial phenomena (ice cover, break-up, duration,etc)

intensity of extension or decrease of inundation areas at certain water levels, etc.

Aerial photoes are also applicable in introducing clarity into the hydrographical characteristics obtained from the topographic maps that are not quite up-to-date. And of course, aerial photography is especially important when a given territory is not well enough known from the topographic point of view. In such circumstances aerial photographs become the main source for hydrographical and hydrological studies of water units, as well as the basis for the planning of water undertakings.

Space photoes inspite of their small scale can and must find a wide application in studying water resources and their rational use.

Space photography being very efficient proves to be the best tool for identifying the dynamics of hydrological processes simultaneously on immense territories of the globe which is very important in making hydrological predictions. In future, as the possibilities of space photography will be increasing and there will be more advanced scientific methods of processing and deciphering of space photographs, space methods of hydrological investigations must play a leading role in the hydrological science.

Finally it should be noted that it is necessary to use more efficiently the cartographic method in studying the country's water resources. This method provides a deeper exposure of interdependence between different hydrological elements and gives a most vivid picture of water resources, their quantity , quality and territorial distribution. Special maps can be developed using the experience of mapping separate regions of the country and the most recent achievements of science and technology.

All this will provide the specialists with invaluable information for elaboration of scientifically based methods of rational water use in national economy.

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Применение картографического метода в изучении и рациональном использовании водных ресурсов

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