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THE PRINCIPLES FOR MONITORING THE CONDITION OF WATER OBJECTS BY USING GEO INFORMATION SYSTEMS TECHNOLOGIES

GAZIYEVA RANO TESHABAYEVNA,
Professor, Tashkent Institute of Irrigation and Agricultural Mechanization Engineers, 100007, Tashkent, Uzbekistan, e-mail: rgaziyeva@gmail.com, tel: +998909561420

ABDULLAYEVA DILBAR AMANBAYEVNA,
Assistant, Tashkent Institute of Irrigation and Agricultural Mechanization Engineers, 100007, Tashkent, Uzbekistan, e-mail: dabdullayeva1972@gmail.com, tel: +998935434366

NIGMATOV AZIZ MAHKAMOVICH,
Assistant, Tashkent Institute of Irrigation and Agricultural Mechanization Engineers, 100007, Tashkent, Uzbekistan, e-mail: anigmatov@gmail.com tel: +998943677991

BOZOROV ELMUROD OSTANOVICH,
Dotsent, Tashkent institute of irrigation and agricultural mechanization Engineers. 100007, Tashkent, Uzbekistan, e-mail: bozorov_e@mail.ru tel: +998974023637

OKHUNBOBOYEVA CHAROS ZUKHRIDDIN KIZI
Assistant, Tashkent institute of irrigation and agricultural mechanization Engineers. 100007, Tashkent, Uzbekistan, e-mail: choxunboboevatjichab@tiiame.uz tel: +998994037788

ABSTRACT:

The purpose of this article is controlling as well as monitoring the changes in the parameters of water bodies using geographic information systems with the use of space scanning and / or aerial photography. The usage of unmanned aerial vehicles (UAVs) when shooting allows you to specify the situation in the problem area.

Moreover, determine the pollution, the distribution of polluting agents in the space and time; determine the rate of occurrence of negative processes, solve the problems of comparability of the results of analyzes carried out by different methods; provide interested users with the information necessary for decision-making (operational and prospective) at various administrative levels.

KEYWORDS: Geographic Information Systems (GIS), monitoring, aerial photography, unmanned aerial vehicle (UAV),

INTRODUCTION:

The deterioration of the ecological state of water bodies leads not only to their degradation, but also to problems of their water management. This happens against the background of a reduction in the network of observations in the state monitoring system, and weakening control over the impact of anthropogenic activities on water bodies [1]. Currently, issues related to identifying sources of negative impact, monitoring ongoing processes, both in the water bodies themselves and within their water protection territories, are relevant. The right solution of these issues, by restoring the network of observation

stations, seems to be insufficient, and even not possible. This is due to the nature and a number of consequences of anthropogenic influence:

• The number of sources of negative impact and their diversity has increased and continues to increase;

• The combined influence of several factors that worsen water quality is another serious cause of danger to water bodies, difficult to detect and develop protection methods.The influence of numerous negative factors, due to the actions of the laws of “Emergence” and “Bowlich” (Reimers, 1990), even with a subthreshold level of their impact on the system, can cause a qualitatively new negative effect;

• The role of causal relationships has increased. The latter leads to the fact that the consequences, caused earlier by any cause, or their combination, develop into causes.For instance, river pollution was initially observed in the connection of the influx of pollution from thewastewater (reason). This has led to the contamination of soil in the bottom stratum (consequence) and, at present, secondary pollution plays (has grown into the cause) a significant role in river pollution. Thus, bottom sediments became a source of pollution [2-4]

BODY PARAGRAPH:

In conditions when the interconnections and interdependencies in the techno-natural system are complicated, it is impossible to control in simple ways. The development of diverse structures and methods are required. This fully applies to monitoring, the basic requirements for which can be formulated as follows.

For the controlling the state of water bodies and justifying the parameters, initially it involves working with cartographic information and with attribute data about objects on the map.To solve such problems, geoformation systems are widely used throughout the world [5].To solve such a number of problems, it is advisable to consider GIS as a meanof storing and processing information in a number of areas of knowledge (cartography, hydrology, geology, ecology, economics, etc.).

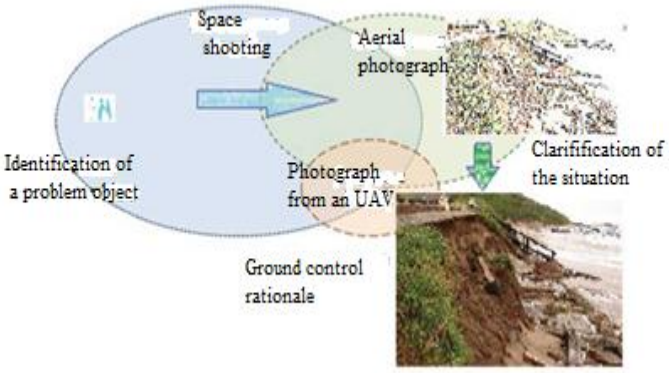
The main advantage of geographic information systems is the ability to perform spatial analysis, i.e. conducting a series of operations on geo-data to obtain the information required for management decisions.

The constancy of controlling and coveraging of large areas through the use of stationary monitoring stations. The constancy of controlling and monitoring of large areas with the help of GIS can be achieved using space scanning and / or aerial photography. High-resolution space and aerial photographs make it possible to get a general idea of the condition of the object and identify possible problem areas, for example: flood conditions, the condition of territories, transfer of runoff, fire hazard, filling reservoirs, etc.).The use of unmanned aerial vehicles (UAVs), when shooting from low altitudes, allows you to specify the situation in the problem area by obtaining additional source data. Analysis of the information obtained will justify the decisions taken. [6]

The efficiency and reliability, against the background of relative simplicity and reduction of labor intensity, is achieved using multilevel control (space control "aero" ground), with partial duplication of information and sufficient frequency for practice. In accordance with the general principle of systemic research “from general to particular”, problem zones are localized, on which specific detailed studies are carried out.

Thus, the development of monitoring using data obtained with the help of GIS is proposed on the basis of continuous monitoring of changes in water bodies and

near water bodies using modern technical means of automation. Development of methods for predicting and assessing the state of objects suitable for different levels of monitoring, taking into account the feedback that is carried out by periodically monitoring the actual state [7]



Picture1. Scheme for tracking changes in water bodies

The monitoring scheme using GIS is as follows: A. Reconnaissance control - analysis of the general condition of water and land objects, with the simultaneous application of various methods: aerospace surveys, ground visual and instrumental surveys, biotesting and calculation methods. The goal is to assess the actual situation and the effects of anthropogenic activities over the past period, to evaluate the emerging trends in the state of the system and to clarify the relationship between the parameters determined by different methods.This control provides a "reference" binding to specific conditions (this type of control can be carried out 1 time in several years, once a year or period of the year, depending on needs). B. Constant monitoring of the situation (at least 1 time in 10 days) allows you to identify problem areas by analyzing ongoing changes and deviations from natural processes. A stationary network of observations, aerospace scanning methods are used with forecasting the situation by calculation methods [8].

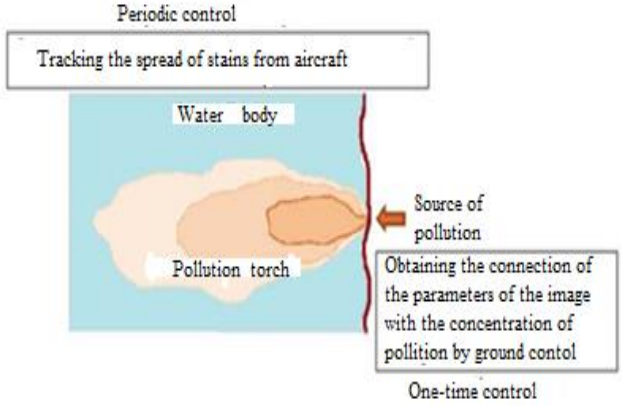


Figure2. The use of GIS for methods of monitoring different levels of pollution.

C. A one-time examination (as necessary) - observations in problem areas, hazardous foci through the use of high-resolution means to obtain parameters that specify the situation.

D. Prediction of the situation on a permanent model of the water system. This allows you to use the information obtained to identify problem areas in which unacceptable deviations from the norm may occur.

The main idea of conducting monitoring studies is to form a block structure based on multi-level division of the territory using a set of tools. Modularity means the allocation of objects that are being monitored (water column, bottom soil, coastline, coastal territory, etc.). In each block, the whole complex of necessary observations is carried out. The data obtained for different blocks should be comparable with each other. Each unit uses the latest technical automation equipment (aircraft, ground-based observations and calculation methods) [9].

Multilevel is associated with the need to cover the entire territory of the investigated object and is built according to the scheme: from the general situation of a large-scale territory to detail, with partial duplication (clarification) of information.

This scheme using GIS allows you to obtain the necessary data for any object as a whole and its individual section, fill in the series of observations (for example, in the case

of loss of some data or missed observations), control the entire territory and obtain data that are spatially temporally comparable [8]

Monitoring is carried out at water bodies including their coastal territories, in the first place - coasts and water protection zones, water management systems and structures. The number of observation targets and their placement is determined by the principles of "Reasonable Sufficiency", "Efficiency", "Manageability" and "Feedback" (Reamers, 1990). This ensures the satisfaction of needs for the implementation of business tasks (the need for hydrological, hydro chemical, hydro biological information).

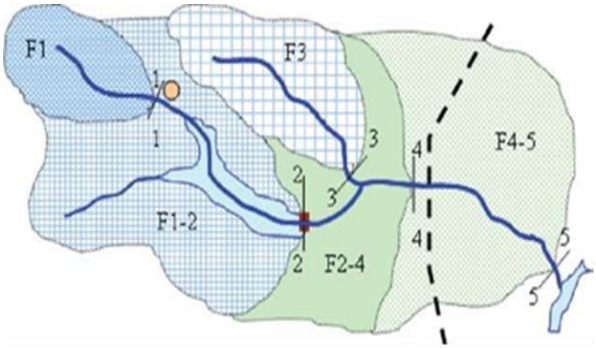
To conduct continuous monitoring of water bodies using GIS, it is necessary to install targets. The placement of control targets is based on the analysis of: natural environmental conditions; nature and intensity of anthropogenic impact; economic and environmental significance of the facilities. In this regard, the following monitoring zones are distinguished.

1. The zone of direct impact - areas of intensive channeling processes, the reformation of coastal territories, river estuaries and their individual sections, waterworks, places of wastewater discharges, flow of sewage, etc.
2. Zone of transit sections - control of water pollution in areas adjacent to zones of direct influence and falling under indirect influence. In these areas, the transformation and spread of pollution are monitored.
3. Background zones - outside areas of direct and indirect anthropogenic impact (for example, the upper reaches of rivers). [9]

Observations in these areas should allow the following information to be obtained: Identify the effects of anthropogenic impact (concentrated and dispersed, direct and indirect) and changes in the environment. In this case, observations are necessary in the sources of impact, in the sections above and below the places of their influence on the river.

Analyze the data, evaluate and forecast changes in the state of the environment as a whole and its individual components. In this case, there is a need to obtain information about the natural (background) state of water bodies and their condition, taking into account the impact.

Observation shutters are installed in places (Fig. 3): lack of direct and indirect anthropogenic influence (or indirect influence is insignificant) - background targets; about the manifestation of processes of natural or anthropogenic origin (landslides, mudflows, flooding, erosion, etc.); on regulated water use planning.To develop an optimal control system based on minimizing the anthropogenic impact on the environment [9].



Picture3. An example of the appointment of targets for monitoring observations

1-1 - background target; 2-2 - hydrostatic target; 3-3 - the mouth of a large tributary; 4-4 - at the border of administrative entities or state divisions; 5-5 - estuary

RESULTS:

The obtained data should allow the formation of long-term series of controlled parameters of water bodies. In this case, the use of calculation methods is taken into account (especially for areas that are not constantly monitored by observations), including analogy methods against the background of zoning of the territory. Zoning is

carried out, for example, on the basis of typification of the main parameters (hydrological, hydrochemical) and conditions for the formation of water bodies. [10]

The scale of monitoring research using GIS is divided into levels, in accordance with the principle of "Hierarchy":

• Global is carried out on the basis of international cooperation (necessary, for example, for monitoring transboundary water bodies);

• National is carried out within the country and its large hinterland, basins of large and unique water bodies, water management systems of national importance;

• Regional is carried out within the river basins, intensively developed areas (for example, megacities);

• Local includes monitoring changes in the quality of the environment within the waterworks, a section of the water body;

• Impact is carried out within a particularly dangerous source. [10]

CONCLUSIONS:

Thus, each level of research with the help of GIS involves the control and monitoring of changes in the corresponding environmental parameters using space scanning and aerial photography.

As well as the use of unmanned aerial vehicles (UAVs), when shooting, it allows you to specify the situation in the problem area, which should allow you to: determine the pollution of various environments, the distribution of polluting agents in space and time; determine the rate of occurrence of negative processes, including the magnitude and speed of the spread of pollutant flows, possible ways of their transformation; solve the problems of comparability of the results of analyzes carried out by different methods; provide interested users with the information necessary for decision-making (operational and prospective) at various administrative levels.

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