Journal of International Scientific Publications: Ecology and Safety

Volume 8, ISSN 1314-7234 (Online), Published at: http://www.scientific-publications.net

ANALYSIS AND ASSESSMENT OF THE SPACE AND TIME CHANGES IN THE WATER QUALITY OF VIT RIVER

Vesela Sht. Raynova

National Insttute of Hydrology and Meteorology

Bulv. Tsarigradsko shose 66, Sofia 1784, Bulgaria

Abstract

The main aim of water control policy is the realization of integrated water pollution control, as well as harmonization of regulation by analogy with of the European Union practice to be assured: balanced water quality control of the nationwide integral water resources. The water pollution, hydromorphology degradation of over-use, soil organic matter decrease, etc., result in harmful effects on the ecosystems as well as on the expectated increase of the pollution and water shortage., The purposes of this paper are, as follows - 1.Analysis and assessment of the basic drainage factors; 2.Hydrographic, hydrologic and hydromorphology characteristics of the river; 3.Assessments of natural factors, influencing to the ecological potential of river waters; 4.Inventorization of the antropogenic influence of the river waters; 5.Application of a chosen method and experiments fo Vit river catcment; 6.Proposal of a program of actions for improvement of the water use control.

Key words: *water quality, water resource management, decision support system*

Water catchment area of Vit river is limited by west - watershed of Iskar river, east by watershed of r. Osam and south of Stara Planina mountain. She is created by merger of Cherni and Beli Vit rivers, just as leaving the mountain the river is headed east-west and after takes east direction, keeping that direction until collision of Dunav river near Somovit. River length is 189km with water catchment area of 3220km^2. Average lean of the river is 9.6%. The catchment area form is strongly elongated (average width 25km), disabling the possibility of thicker river network. Density is almost 0.5km/ km^2. Average multiannual water amount of the river is barely 13m^3/sec. Number of rivers started from it is small. Vit river has almost 10 river spreads with length over 10km. Biggest are Kamenska river (length of 49km) and r. Tuchnitsa (length of 35km and area of 260km^2) and. Kalnik river (length of 41km and area of 260km^2). Average year annual minimum of drainage of Yasen station is 2.13 m^3, the absolute minimum - 1.15m^3. The area of Vit river's waters is 3227,565 km^2.

There is one big karst river located on river Vit's water area with length of 124,58km and one loess river with the length of 33,93km. Afore mountain rocky type both rivers are with length of 69,34km. Little and middle karst rivers are 4 with total length of 241,34km. Along river area there are 8 tributaries with total length of 469,19km.

Natural chemical composition of water of Vit river is determined by loess, lime stones, dolomites – rich rocks of soluble materials and the typical for North Bulgaria black soil. Especially important matters are the components calcium and magnesium. Hydrocarbon ions are created by disintegration of carbon rocks under the impact of carbon dioxide and coil acid separation.

Hydroformological features of Vit river catchment are mainly located in the creation of natural chemical composition of waters. According to Maksimowich's classifications, this river waters fall into hydro-carbon-calcium-sulfate fraction. Main cause for this is hydrological norm of the water area, the specific form and type of feeding and characteristic litho logical type of the area.

The review of the basic anthropogenic influences shows clear, that main cause of anthropogenic load is connected to the assessments of oxygen norm of the river and load of nitrogen and phosphorus. Big part of the pollutions comes from agriculture, water loss and waste, result of livestock and usually thrown directly into the source.

In the meantime use of different means for plant safety and mineral fertilizers in crops make diffuse pollutants. Typical for those types of pollutions is that they don't have a specific time to return into the source pool. They easily reach soil waters and from it - the rivers. Great danger is caused by the illegal landfills for waste or different kinds – industrial, construction, storage of a big amount of means for handling agricultural production, mineral fertilizers and others.

Precicely based on that are put together selected data, enough for making a complex assessment of water state in this current, therefore they are:

I.From alltogether phisics components: carbon ph, conductance

II.From assessments showing the organic pollutions: open oxygen, biochemical concumation of oxygen, permaganne oxyzation.

III.From specific assessments showing the pollutions from bussiness and bit sector: ammoniem nitrogen, nitrite nitrogen, nitrate nitrogen, ortophosphate, sulphate ions, hydrocarbon ions, calcium ions, magnesium ions

Assessments are selected as showing at most the main pollutions of this sector

The combining method, based on it a assessment is developed in Canada in the end of the 90s of the past century and being used in Bulgaria for assessment of water quality, many times. Those assessments have three components, linked to the antropogen influence on qaulity of waters:

Advantages of the used methodology:

1. Allows to obtain a more complete and thorough description of the anthropogenic impact, as well as the types and forms of pollution of the water bodies.

2. The status of the river current in different areas can be determined through summarized unambiguous result.

3. One of the advantages of the method is the relatively clear and easy for implementation algorithm with the use of accessible mathematical mechanism.

4. The method makes it possible to construct a different number and type of component parameters and characteristics, sets of ingredients and reference SLV, as well as the opportunity to include in the study biological ingredients such as coli titer and coli index.

The evaluation of the status on one hand is a criterion for the acomplishment of the goals of WFD (Water Framework Directive) and for identification of areas at risk. On the other hand it is a factor for evaluation of the condition in order to support the act of decision making and development ot the measures for adaptation. The result is unambiguous. This form of complex assessment is a reliable indicator which can support the implementation of already developed methods and models adopted in the first Plans for River Basin Management (PRBM) as well as the management of the water distribution in extreme conditions.

The second important aspect is to take into consideration the status of the waters as an indicator for risk when linking the water development balances and extension of the conflict nature of water use in extreme conditions. This evaluation may be included in the decision support systems which are being developed in the moment. The foundation is the DPSIR approach of WFD. The assessment for achievement of the ecological goals of the water bodies is the so called "Indicator of impact", which in conjunction with the other indicators guide the selection of appropriate measures such as: management of water supply, management of dams and water equipment, specific permit conditions, etc.

A water quality index provides a single number (like a grade) that expresses overall water quality at a certain location and time based on several water quality parameters. The objective of an index is to turn complex water quality data into information that is understandable and useable by the public. This type of index is similar to the index developed for air quality that shows if it's a red or blue air quality day. The use of an index to "grade" water quality is a controversial issue among water quality scientists. A single number cannot tell the whole story of water quality; there are many other water quality parameters that are not included in the index. The index presented here is not specifically aimed at human health or aquatic life regulations. However, a water index based on some very important parameters can provide a simple indicator of water quality. It gives the public a general idea the possible problems with the water in the region.

The calculation of index scores in CCME WQI method can be obtained by using the following relation:

$$WQI = 100 - \frac{\sqrt{F_1^2 + F_2^2 + F_3^2}}{1.732}$$

where,

Scope (F1) = Number of variables, whose objectives are not met.

F1= [No. of failed variables /Total no. of variables]*100

Frequency (F2) = Number of times by which the objectives are not met.

F2 = [No. of failed tests/Total no. of tests]*100

Amplitude (F3) = Amount by which the objectives are not met.

(a) excursioni = [Failed test valuei /Objectivej]-1

(b) normalized sum of excursions (nse) = $\sum_{i=1}^{n}$ excursionsi /No of tests

(c) F3 = [nse/0.01nse+0.01]

Table 1. Interval scheme for assessment of the waters through their quality

Category Assessment of the condition	**Interval** **WQI**
Excellent The waters are in their natural state. No anthropogenic impact.	95-100
Very Good The waters are in their natural state. Single cases of human impact are registered.	80-94
Good The waters are generally defined as clean, but cases of anthropogenic impact are registered. Slightly polluted waters.	65-79
Critical The waters are subject to a significant degree of anthropogenic impact. Polluted waters.	45-64
Bad The waters are subjected to continuous anthropogenic impact. Very polluted waters.	0-44

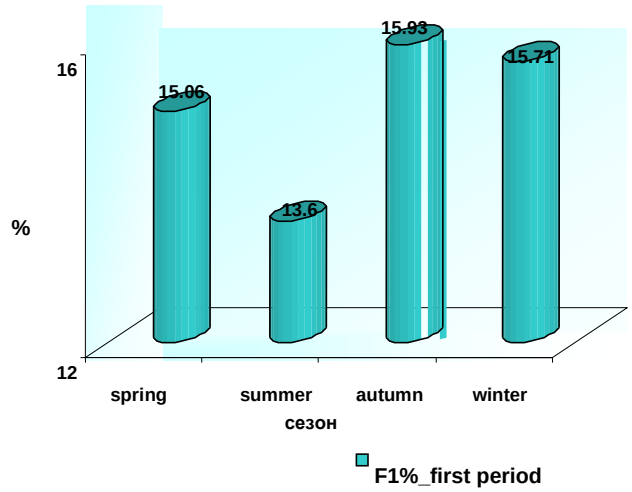


Fig. 1 The indicators which exceed SLV towards the total number of indicators on seasonal basis (F1)

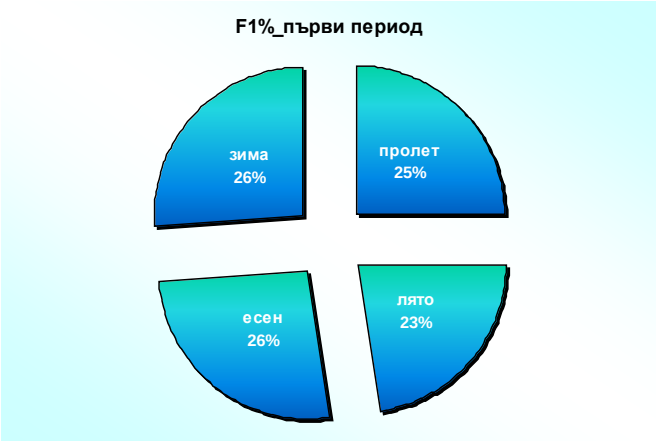


Fig. 2 Season distribution of indicators which exceed SLV

RESULTS

The analisys of the quality of the watess is made for two periods from 1990 – 2000 and 2001 – 2011 and the calculations are made on seasonal basis. The values of the range of influence for the first period are between 13 and 16% (fig.1). For the second are from 13% to 19% (fig. 5). The frequency varies from 89% to 96% for the first period (fig. 3) and from 73% to 93% (fig. 7). Figure 9 shows the alteration of the water quality index on seasonal basis.Figure 2 and figure 6 shows the season distribution of indicators which exceed SLV for two periods. Are Season distribution of the samples which exceed SLV shows in the figures 4 and 8.

The analysis of the results for the index of water pollution (WQI) of the Vit river shows: the ecological condition of the Vit river at its mouth does not meet the requirements laid out in the Framework Directive 2000 \ 60EU (WFD) establishing the framework of the EU policy in the field of waters. The values for the two periods fall into the category of waters exposed to continuous anthropogenic impact - very polluted waters. In terms of the categorization as environmental condition, conformed with the given referent values, it is in the category "bad." The lowest value of WQI was in autumn 1990 - 2001 and is 28. The waters in this area of the river are unusable.

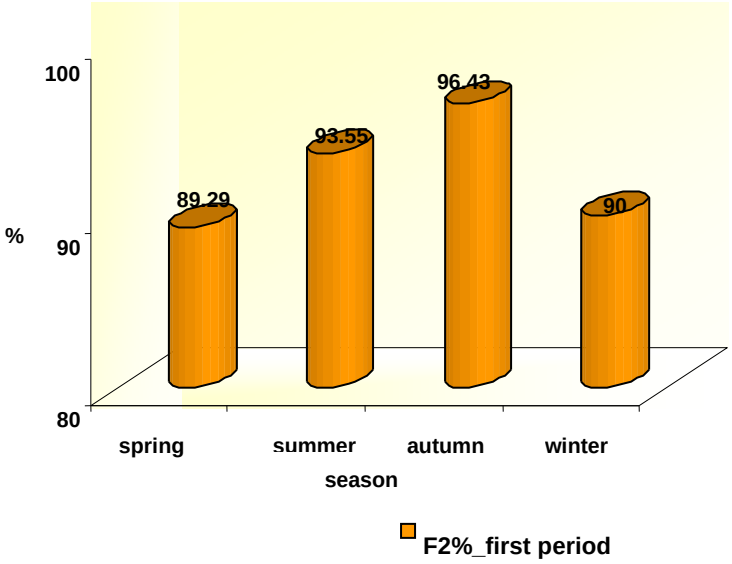


Fig. 3 Number of the samples which exceed SLV towards the total number of samples (F2)

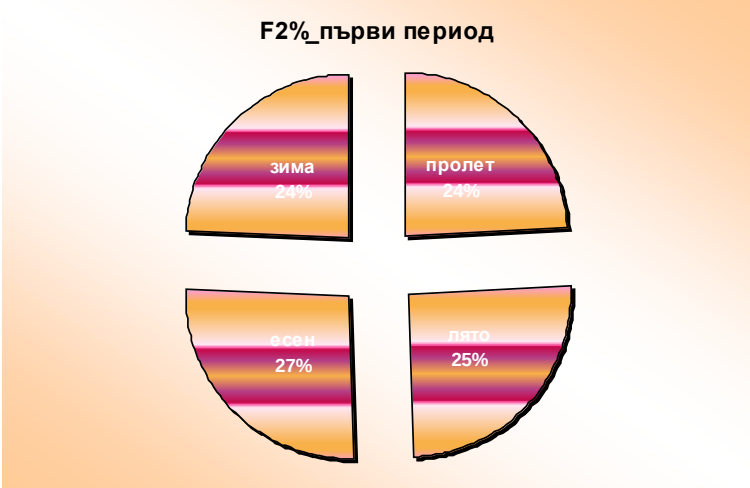


Fig. 4 Season distribution of the samples which exceed SLV

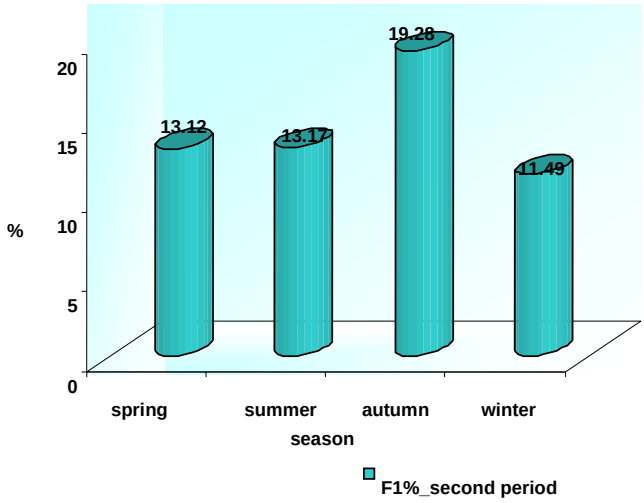


Fig. 5 The indicators which exceed SLV towards the total number of indicators on seasonal basis (F1)



Fig.6.The indicators which exceed SLV towards the total number of indicators on seasonal basis (F1)

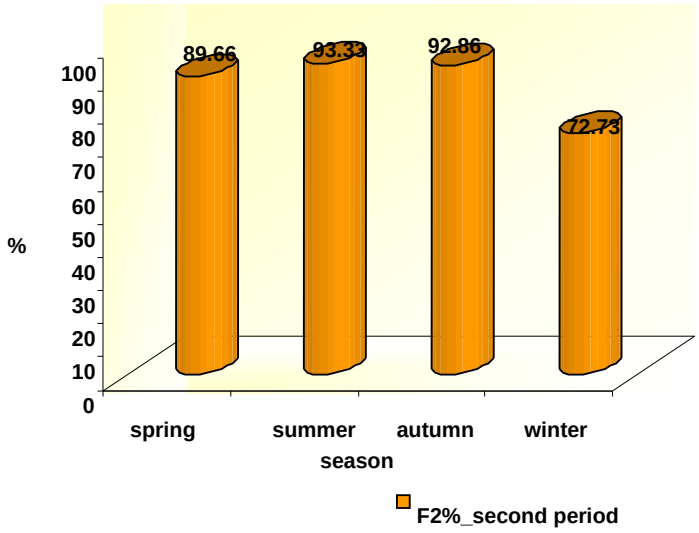


Fig.7 Number of the samples which exceed SLV towards the total number of samples

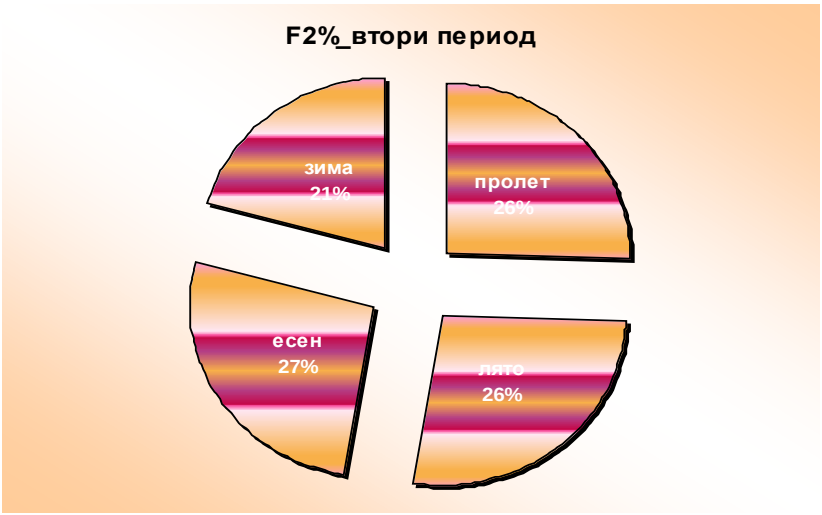


Fig.8 Season distribution of the samples which exceed SLV

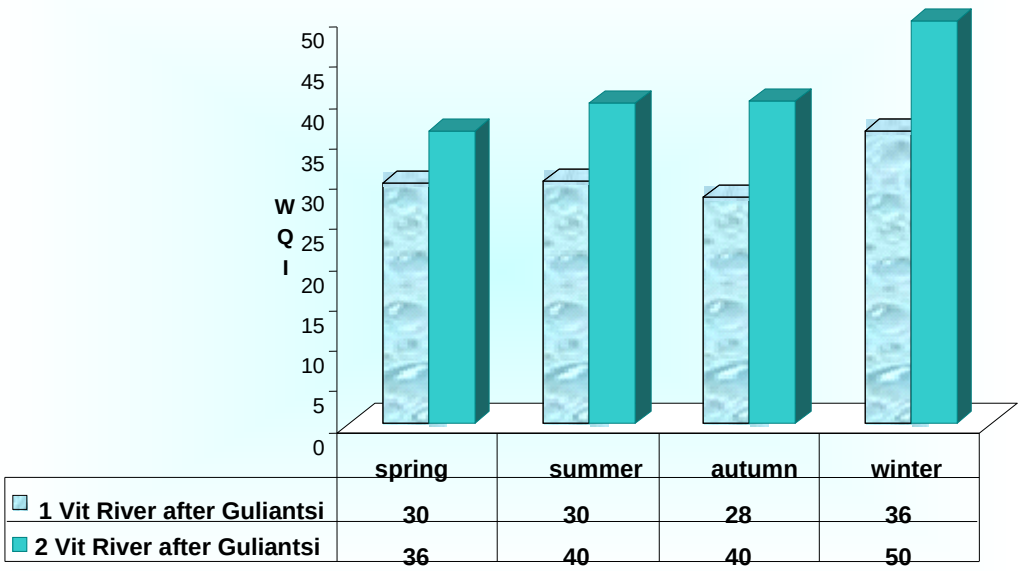


Fig.9 Alteration of WQI on seasonal basis for the two examined periods

The measures should be mainly aimed at creating conditions for the maximum utilization of the waters of Vit River. Three aspects of the package of measures are examined:

1. Measures for the preservation of the water resources, which include:

- To ensure management of the water resources on basin principle to ensure the most efficient use and protection of the water resources, as well as protection of national interests
- Additional regulation of the outflow
- Provision of the ecological outflow in the river
- Preservation or elimination of drilling which release underground waters which are not used
- Provision of treatment of waste waters mouthed in the water bodies i.e. design and construction of the infrastructure for collection and purification of waste waters from the towns and villages with over 10,000 population equivalents and gradual preparation for the construction of Urban Wastewater Treatment Plants (UWTP) in settlements between 2000 and 10 000 equivalent inhabitants.
- Actualization of the water monitoring system which provides objective data for assessment of water resources and prognosis for their changes.
- Improvement of the forest management in the water supply zones and banning clear felling (except acacia and poplar). This includes planting of appropriate tree species.
- Erosion control and reduction of the amount of unused run off water.

2. Measures to provide water for irrigation.

- Improvement of the management, usage and preservation of the water resources in the watering agriculture.
- Reassessment of the built irrigation systems in terms of their water provision and quality of waters.
- Stimulation of the application of water saving, energy saving and ecological technologies and techniques for irrigation of farming crops.
- Development of irrigation fields with provided local water sources (in the case of the Dunabe feeders – usage of the underground waters).
- Introduction of appropriate methods and tools for measuring both the quantity and quality of the water in the irrigation systems.

- Examination and application of appropriate technologies and techniques for usage of treated waste waters and examination and reuse for irrigation of the waters from the drainage systems.
- Studying the vulnerability of crops to climate change, prolonged drought and water deficit in the examined agro-climatic regions.
- Usage of appropriate technologies to collect and preserve water during snowfall and snowmelt, due to the expected greater precipitation during the winter season. Rainfall during the cold part of the year to be used for irrigation of perennial plants and wintering crops with adequate facilities.

  3. Developing knowledge and awareness of the best possible utilization of the water resources.
- Assessment of flood risk, drawing up a maps of the regions at risk of flooding and usage of the hydrological forecasts and early warning of natural disasters systems.
- Assessment of the risk from drought and its impact on the river waters quality and ecosystems. In 2011 - in places along the Danube river in its Bulgarian area, according to information from the Executive Agency "Exploration and Maintenance of the Danube River", in November were measured the lowest levels since 1941. In the today's conditions the riverbed quickly washes away. The hydromorphological research of the mouth station of the Bulgarian tributaries indicate that excavations have come to 2m in depth and the erosion processes have intensified. These irreversible changes of the landforms have a negative impact on the ecological status of the examined water bodies.
- Improvement of the quality and quantity monitoring is necessary, which will provide data for effective management of water resources, and this monitoring should be in accordance with the European regulations for standards for sampling, analysis and evaluation of water quality, thus to obtain comparable data.
- Implementation of the activities provided in the existing plans for management of the protected areas along the Danube River.
- Improvement of the collection and transportation of waste from human settlements. Imposing severe penalties for detection of illegal dumpsites.
- To prevent settlements from flooding in order to minimize the potential adverse effects on human health and the environment and to reduce the risks by implementing sustainable measures against floods.

REFERENCES

Varbanov M., Use of combinatorial indexes for complex evaluation of river water quality, journal Problems of Geography, Sofia 2007

Tsankov K. , S.Blaskova, P. Ninov Aims and Problems in the Process of Quality Composition Investigations of the Big Plane Rivers on the Example of the Danube, Symposium on Water Pollution, pp. 245 - 252, Milano, 1993.

Niagolov,I., Ilcheva, I., Yordanova, A., Georgieva, D., 2013,Managment of water systems of the danube tributaries in extreme conditions, Danube day, STU,Sofia, june 2013

General schemes for usage of the waters in the regions for basin management, 2000, project of the Ministry of Environment and Water of Bulgaria.

CCMECanadian Water Quality guidelines for the protection of aquatic life:Canadian Water Quality index 11. 0 Tehnical report . Canadian Council of Ministers of theEnvironment. 2001.

Bharti, N. and Katyal, D, “Water quality indices used for surface water vulnerability assessment”, Int. J. Environ. Sci., 2(1). 154-173. 2011.

Assessment of the water quality in river basins with intensive agricultural activity (on the example of the rivers Vit and Osam) K.Gartsiyanova, Sofia 2010

Ansari, K. and Hemke, N. M., “Water quality index for assessment of water samples of different zones in Chandrapur city”, Int. J. Engineer. Res. Appli., 3(3). 233-237. 2013. Големите български притоци и екологичния статус на р.Дунав, сп.Минно дело и геология,В.Райнова, бр.3-4, 2013г., София