

SCIENTIFIC OPINION

By: Assoc. Prof. Emilia Ivanova Tcherkezova, PhD, National Institute of Geophysics, Geodesy and Geography at Bulgarian Academy of Sciences (NIGGG-BAS), Department of Geography, Section "GIS"

Subject: Dissertation for awarding the educational and scientific degree "doctor" in scientific field 4. Natural Sciences, Mathematics and Informatics, Professional field 4.4. Earth Sciences („Terrestrial hydrology and water resources “)

Author of the dissertation: Kalin Krastev Seymenov

PhD-Thesis: Assessment of River Runoff and Water Resources in the catchment areas west of the Ogosta River

Scientific Supervisor: Prof. Nelly Hristova, PhD

Reasons for preparing the scientific opinion: Participation in the scientific jury of the dissertation defense according to the order № RD-38-40/22.1.2024 2023 of the Rector of the "St. Kl. Ohridski University" Prof. G. Valchev, PhD.

This scientific opinion has been prepared in accordance with the requirements of the Law for development of the academic staff in the Republic Bulgaria, the Regulations for its implementation, the Regulations on the Terms, and Procedures for Acquiring Scientific Degrees and Holding Academic Positions at "St. Kliment Ohridski" University, Sofia.

1. General description of the submitted materials

The PhD candidate Kalin Krastev Seymenov has presented a set of documents in connection with the procedure for awarding the educational and scientific degree "doctor".

They comply with the requirements of the of the Law for development of the academic staff in the Republic Bulgaria, the Regulations for its implementation, the Regulations on the Terms, and Procedures for Acquiring Scientific Degrees and Holding Academic Positions at "St. Kliment Ohridski" University, Sofia.

2. Short biography of the PhD candidate

The PhD candidate Kalin Krastev Seymenov was born on August, 22, 1995. In 2018 he obtained a Bachelor's degree in Geography (2014-2018) at the Faculty of Geology and Geography, "St. Kl. Ohridski University", and in 2019 – a Master's degree in in Geography/ „Climate change and water management“ (2018-2019) at the same faculty.

Between February 2020 and January 2023 the PhD candidate is full-time PhD student –PhD program "Hydrology of Land and Water Resources" (professional direction 4.4. Earth Sciences) at the Department of "Climatology, Hydrology and Geomorphology" of the Faculty of Geology and Geography – "St. Kliment Ohridski" University with scientific supervisor Prof. Nelly Hristova, PhD.

3. Actuality of the doctoral thesis

The dissertation is dedicated to the analysis and assessment of river runoff and water resources in the watersheds west of the Ogosta River (NW Bulgaria).

The PhD candidate substantiates the relevance of the issue with established trends towards a decrease in annual, monthly and seasonal water volumes as a result of rising air temperatures and anthropogenic influences, an increase in the frequency of extreme

hydrological events, as well as an increase in the volume of water use and deterioration of water quality.

4. Characterization and evaluation of the PhD thesis

The electronic version of the dissertation is 212 pages long, of which 133 pages are text and 79 pages are appendices. The bibliography includes 142 titles, of which 86 are in Cyrillic and 56 are in Latin. The dissertation has 27 figures, 46 tables and 14 appendices. It can be assumed that the sources used (primarily literary) are sufficient to achieve the purpose of the research. The dissertation is structured as follows: introduction, four chapters, conclusion, bibliography, and appendix.

In the introductory part, the relevance and scientific significance of the dissertation research are argued. In it, the PhD candidate defines the object, the subject, the goals and tasks of the research, as well as the study area and limitations of the work. The river runoff and water resources in the catchments of the rivers Topolovets, Voynishka, Vidbol, Archar, Skomlya, Lom and Tsybritsa were studied.

These drainage basins are separated into an independent river basin "Rivers west of Ogosta River" according to the "River Basin Management Plan" (RBMP) of the Basin Directorate, Danube Region (BDDR).

A brief and well-synthesized summary of the structure of the dissertation has been made.

The first chapter presents the theoretical and methodological foundations of the dissertation research with a description of existing approaches and methods for quantitative assessment of river runoff and water resources and for qualitative assessment of water. The presented text shows a good theoretical preparation of the doctoral student related to the subject of the dissertation research.

The second chapter includes a description of the study area, the data sources and the methods used. Natural geographic (with an emphasis on hydrographic description of the rivers and water bodies), administrative-territorial and demographic characteristics of the study area has been made.

The initial hydrometric data sets (spatio-temporal and quantitative parameters of the river runoff), as well as data from the monitoring of surface water bodies (information on the measured content of ten physicochemical indicators) and data from the monitoring of surface water bodies (information on the measured content of ten physicochemical indicators), which were used are presented in a synthesized form, citing their sources, the location of the hydrometric stations (HMS) and monitoring points (included in the National Environmental Monitoring System - NSMOS of the Executive Environment Agency (ExEA), as well as their time range.

The methodological approach of the PhD thesis is based on general scientific (analysis, synthesis, comparison and summary), cartographic, graphic and statistical approaches and methods, as well as on hydrological methods (e.g. index for assessment of the water stress and quality).

In the third chapter, the factors conditioning the river waters quantity and quality in the study area are presented. They are grouped as follows: a) natural-geographic - climatic, morphographic, geomorphological, geological and hydrogeological, hydrographic factors and hydrological conditions, soil cover and forest cover and b) anthropogenic factors determined

by agrarian activities (hydromelioration activities, agriculture, animal husbandry), the utility and industrial sector and the production of hydroelectric energy.

In the fourth chapter, the dissertation presents the results obtained from the quantitative assessment of river runoff and water resources and analysis of river water quality in the researched area.

The quantitative assessment of the river runoff and water resources was made on the basis of statistical characteristics of the annual river runoff and the average multi-year runoff, presenting double sum curves of the annual runoff, the results of non-parametric tests for homogeneity and type of distribution, and descriptive statistics of the annual runoff by conditionally undisturbed and disturbed outflow.

The multi-year dynamics of the river runoff was analyzed on the basis on the analysis of moving average values and integral difference curves. The trends in the multi-year runoff dynamics in all studied river basins were analysed applying a linear trend method.

The degree of probability of annual streamflow is presented. Based on the Falkenmark Index, the volume of water resources is calculated and the freshwater availability per capita per year is estimated. The obtained results enable the PhD candidate to determine the watersheds with predominant water stress, shortage and absolute shortage of water, as well as to analyze the water resources in the studied area. In addition, a characterization of water use in each of the studied watersheds was made on the basis on literature.

In the following dissertation's subsections, the PhD candidate presents the periods of high and low water, the monthly and seasonal dynamics of the river runoff, as well as the extreme events (frequency, duration and amounts of extremely high and low runoff) in the studied drainage basins.

Separately the results of a component and composite analysis of surface water quality in the studied area has been presented.

The component analysis was used to determine the physicochemical state of the waters through 10 physicochemical indicators (hydrogen indicator pH, electrical conductivity, dissolved oxygen, ammonium nitrogen, nitrate nitrogen (N-NO₃), nitrite nitrogen (N-NO₂), total nitrogen (N -total), orthophosphates (P-PO₄), total phosphorus (P-total), biochemical oxygen consumption (BOD₅) and threshold value - the maximum permissible concentration for achieving "good status" specified in Regulation No. H-4/14.09 .2012 for the characterization of surface water according to the typology of the water body and the corresponding boundary reference requirements.

The composite analysis of the surface water quality was carried out on the basis of the analysis of the annual and average annual values of the index combinatorial index CCME WQI (Canadian Council of Ministers of the Environment Water Quality Index), and the obtained results show that in the period 2015-2020, none of the physicochemical parameters in any of the samples in the specified points exceeded the reference norms for "good condition" specified in Regulation No. H-4 /14.09.2012, which corresponds to "unpolluted waters".

The obtained results and data on the land cover give the author a basis for making a territorial differentiation in the quality of the waters in the studied area.

In conclusion, the obtained results are formulated and summarized. The conclusions, although briefly presented, correspond to the general theme of the research presented in the dissertation work.

5. Evaluation of scientific and applied results and contributions

The formulated scientific contributions of the dissertation student Kalin Seymenov have three main aspects: scientific, scientific-applied and scientific-methodological.

In my opinion, from a scientific point of view, the following contributions, achieved on the basis of a quantitative assessment of river runoff and water resources, are significant - they have been established: a) statistically significant negative trends in the change of the river discharge; b) changes in the intra-annual distribution of water quantities and c) manifestations of altitudinal zonation of a number of hydrological parameters. In addition, a positive trend in the quality of river waters in terms of physicochemical and integral indicators has been proven.

In a scientific and applied aspect, the volume and water resources supply in the studied catchments are documented. In addition, activities related to reducing the loss of water resources and improving the quality of river water have been proposed.

In a scientific-methodological aspect, the PhD candidate emphasizes the use of a large number of methodological approaches and methods, which were used to calculate and analyze numerous hydrological quantities. It focuses also on the complex quantitative and qualitative assessment of the river runoff and water resources in the studied catchments.

6. Critical notes and recommendations

I do not find any serious omissions or misstatements in the dissertation research. I believe that the conclusion should be more detailed, regardless of the fact that individual chapters contain brief summaries of the obtained results.

In my opinion, it would be possible to formulate the contributions of the dissertation work more precisely, so that they could be more precisely highlighted and evaluated by non-narrow specialists as well.

I recommend the PhD candidate to continue his research in this direction.

7. Evaluation of the publications related to the dissertation

The PhD candidate has submitted two publications, related to the dissertation theme and the main research problem – one in Bulgarian and one in English.

8. Evaluation of the abstract

The abstract has a total volume of 36 pages and adequately reflects the structure and content of the dissertation work. It meets the requirements established, containing the main results achieved in the dissertation research, a sufficient number of figures, as well as a reference to the contributions and publications.

9. Conclusion

The dissertation "Assessment of river runoff and water resources in the drainage basins west of the Ogosta River" with author Kalin Krastev Seymenov contains scientific, and scientific-applied results that represent a contribution to the study of water resources and assessment of river runoff

In my opinion, the dissertation meets all the requirements of the Law for development of the academic staff in the Republic Bulgaria, the Regulations for its implementation, the

Regulations on the Terms, and Procedures for Acquiring Scientific Degrees and Holding Academic Positions at "St. Kliment Ohridski" University, Sofia.

The dissertation shows that Kalin Krastev Seymenov has the necessary theoretical knowledge and professional skills to conduct independent scientific research.

Due to this statement, I give my positive assessment of the conducted dissertation research on the basis of the dissertation work, abstract and other publications presented to me for opinion, as well as due to the achieved results and contributions.

In accordance with the arguments presented in this scientific opinion, I categorically state my positive assessment of the presented dissertation and recommend the members of the Scientific Jury **to award the educational and scientific degree "doctor"** to the PhD candidate Kalin Krastev Seymenov in the scientific field 4. Natural Sciences, Mathematics and Informatics, Professional field 4.4. Earth Sciences „Terrestrial hydrology and water resources“.

Date:
3 April 2024

Member of the Scientific Jury:
/Assoc. Prof. Emilia Tcherkezova, PhD/