

Opponent's review of doctoral thesis
Water Resources Management in Kurdistan (Iraq),
Case study of Khazir Basin

by

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a/ Assessment of the fulfillment of the set goals of the work

The work aims to meet a set of very ambitious goals. The author was to propose the optimization of water resources management in the Kurdistan region on the basis of a comprehensive assessment of hydrogeological conditions and their integration into the broader socio-economic context. I can state that the work fulfilled this goal very well. The justification for this statement is documented in the following sections of the report.

b/ Comments on the problem-solving process and the results

The assessed work has one indispensable contribution, which must be highlighted and appreciated. It is a comprehensive framework of solving the problem of water resources management. The evaluation is based on hydrogeological issues. It provides data on natural groundwater resources and their exploitable parts. The author places this information in the framework of climate change, which can significantly affect it. However, the most valuable part of the work, which documents the author's broad professional scope and ability of synthetic thinking is the inclusion of the issue of water resource management in a broader socio-economic context. The work shows that the lack of water in the area of interest, with all its consequences, is not just a scientific issue.

The author correctly points out other causes and proposes solutions. These are mainly changes in the organization of management, in the legislation and in the introduction of new technologies. The socio-demographic analysis shows increasing pressure on water abstraction in Kurdistan. However, this problem can be eliminated by reducing consumption. The figures clearly show large reserves in this area. Therefore, the author could include within the proposed solutions educational activities among the population.

I see another incomplete solution, this time aimed at the organizational area. More concretely, it is in the appropriate setting of the so-called Water pricing policy, stimulating all players in the field of using water resources for saving. In this area, I would like to call on the author next time for a somewhat clearer and bolder formulation of best practices.

c/ Importance for practice and for the development of science

The significance of the assessed work lies on two levels. The first is the methodological area, because the work shows how to optimize the management of water resources in difficult conditions, to which Kurdistan definitely falls. The author's solution methodology can be used as a perfect manual for similar regions.

At the same time, however, the work contains a unique set of extremely diverse data sets necessary to translate the above-described scientific goal into practice. The author's ability to collect data from such diverse fields as climate, geology, hydrology, but also demography, sociology, economics and legislation should be highly appreciated. He proved his ability to work scientifically mainly in his ability to work meaningfully with this data and connect it into logical connections.

d/ Formal arrangement of work

It is necessary to highlight the extraordinary scope of the submitted doctoral thesis, which contains 191 pages of text, 49 tables and 69 images. With the total scope of the work is 262 pages. Not only for the opponent, but also for a reader, this work places relatively high demands on orientation. Nevertheless, it can be stated that the author chose a logical

structure, divided into 6 basic large thematic blocks, divided in some cases up to 10 sub-chapters. The author was probably aware of the problem arising from the extremely rich text and therefore prepared a comprehensive introduction to the work, which will introduce the reader to the topic in a suitable way.

I have only one critical comment on the structure of the work. In my opinion, the introduction and description of the objectives of the work should be logically followed by a chapter characterizing the study area. It provides detailed information on the climatic, morphological, geological and hydrogeological conditions of the area of interest. However, within the current division of the work, this data is missing for the reader in the chapter on water resources management, which precedes the description of the study area.

With regards to the very complex focus of the assessed work, which correctly places the issue of water resources management in a broader socio-economic context, I also lack some information in the chapter "Study area", which is discussed in detail in the conclusion. These are data influencing water consumption on population density and development, land use, economy (industrial and agricultural activity) and the like. These gradually appear in other chapters, but in summary form they deserve to be summarized in the description of the territory.

From a formal point of view, the work is at a high level. All graphic attachments, pictures, charts and maps are of very good quality and are well linked to the text. Due to the extraordinary scope of the text, I appreciate that the author included in his work a sufficient number of graphic links, which made the work understandable.

In the text, the author consistently distinguishes his own ideas from the taken data, which he quotes in the optimal scope and form. Based on a detailed check, I can state that all citations are listed in the list of references.

e/ Author's publications

The author published his results in two articles. In both cases he is listed as the first author and in both cases he is a publication in peer-reviewed journals with an impact factor. This guarantees independent scrutiny in an international forum.

f/ Conclusion

I recommend the doctoral thesis for admission

In Prague April 9, 2021

Zbyněk Hrkal

