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Review

on the dissertation work of Eng. Bisera [redacted] Ivanova entitled

Ecological Approach to Structural Planning in Energy Projects from Renewable Sources

submitted for awarding the educational and scientific degree "Doctor" in professional field 5.7. "Architecture, Civil Engineering and Geodesy" and scientific specialty "Land Management and Protection of Agricultural Land (incl. Property Management)"

by prof. Milena [redacted] Moteva, PhD, Eng.

1. General information of the doctoral student

Eng. Bisera Ivanova has graduated from the Spanish Language School "Miguel de Cervantes" in Sofia. She has continued her education at the University of Architecture, Civil Engineering and Geodesy, majoring in "Geodesy" and has specialized at the Department of "Sustainable Land Use and Real Estate Management". In 2020, she has obtained a "Master's" educational and qualification degree. After graduation, she has worked as a software developer in an international technology company, which has allowed her to apply the acquired knowledge in the field of spatial data and three-dimensional modelling. After successfully passing a competition, she was enrolled in a full-time doctoral program in professional field 5.7. Architecture, Civil Engineering and Geodesy, scientific specialty "Land Management and Protection of Agricultural Land (including Real Estate Management)" by Order No. 164 of 26.02.2021 of the Rector of UACEG. At a subsequent stage, she has switched to a part-time form of study. She was released with the right to a defence by order No. 296/01.04.2025 of the Rector of UACEG. Since 2022, she has been appointed as an assistant professor at the Department of "Sustainable Land Use and Real Estate Management" at UACEG. Within the framework of her teaching activities, she currently teaches exercises in "Agricultural Territory Planning", "Protected Areas Management", "Property Management", "Ecology", "Geodesy" and "Territorial Development". Along with her teaching and research work, she actively participates in the academic and organizational life of the university as a member of the Academic Council of UACEG within the current mandate.

Eng. Ivanova also participates in the development of scientific projects in the field of spatial planning. She also participates in the development of General and Detailed Development Plans. This practical experience contributes to a connection between her teaching, research, and design activities.

2. General characteristics of the dissertation and abstract – volume and structure

The dissertation work contains 116 pages of main text (pp. 8–123), with 10 figures and 12 tables included in it. The work is structured in six chapters. The dissertation includes all the necessary components of a dissertation work in terms of content, but in terms of composition it deviates slightly from the traditional scheme. The traditional Introduction is included as the first item "Relevance and Significance of the Scientific Problem" in Chapter One. After it, the object, subject, goal and tasks are defined, and the expected result of the implementation of each task is also indicated. This chapter also indicates the hypothesis of the study, the scientific field, the methods used and the scope.

In Chapter Two, a review of the state of the scientific problem is carried out. The in-depth analysis begins with a retrospective one of the idea of sustainable development, after which the main international and European documents and agreements, relevant to the topic of the dissertation are reviewed. The national policies prepared on this basis with their priorities and goals are analysed. The gaps and shortcomings of the prepared national documents are critically indicated.

As a result of the review and analysis of the reviewed strategies, policies and planning documents in the field of climate and renewable energy, key conclusions with direct relevance to the topic of the dissertation are synthesized. A logical chain of strategic dependencies and the resulting conflicts in the planning of Photovoltaic Power Plans (PPP) is substantiated. The regulatory features of the construction of PPPs in agricultural territories are highlighted, and regulatory gaps are noted. The potential environmental impacts of the construction of PPPs in agricultural lands are examined. The experience of other countries in Europe and the world in PPP location in agricultural territory is analysed, which allows identifying good practices for adaptation to the regulatory features of Bulgarian legislation. The Chapter ends with summaries and conclusions, which note the discrepancy between strategic goals and their implementation in spatial planning and the lack of an integrated toolkit for systematic consideration of territorial compromises, related to the energy transition.

The methodological framework of the dissertation is developed in Chapter Three. It is based on the application of an ecological approach in spatial planning. It considers the territory as a system of interconnected ecological and spatial elements, the functioning of which is influenced by anthropogenic processes and management decisions. The methodological framework includes the DPSIR procedure (Drivers–Pressures–State–Impacts–Responses) for systematizing cause-and-effect relationships and multi-criteria assessment for comparing and ranking territorial alternatives for PPP. The use of multi-criteria analysis is justified for structuring complex problems in a system of clearly defined criteria, converting different scales of measurement into comparable units, determining relative weights according to their significance and applying algorithms for ranking and selecting the optimal alternative. The use of the Analytical Hierarchy Process (AHP) is described with its advantages and methodological limitations. The main stages in determining the relative weights using this method and the main stages of expert assessment are defined.

The following Fourth Chapter presents the methodological guidelines for applying the ecological approach when selecting a territory for PPP in the General Development Plan (GDP). They represent a tool for systematizing and objectifying decision-making in conditions of numerous competing environmental, social, technical and economic factors. At the conceptual level, the DPSIR model is used to structure the cause-and-effect relationships in the system and to define assessment criteria that take into account environmental constraints and spatial interactions. At the operational level, the AHP method is applied for expert determination of the relative weights of the criteria. As a result, a standardized basis for calculating a summarized assessment is formed. The main stages of the methodological guidelines are described, which turns them into a consistent procedure for practical application in spatial planning at GDP level.

The Fifth Chapter demonstrates the application of the methodological guidelines for the assessment and selection of a specific territory for construction of PPP. The territories of two municipalities with different natural, geographical and socio-economic characteristics were selected to test the methodology. This creates an opportunity to verify the applicability of the proposed implementation stages in a territory with a strong conflict between energy restructuring and agriculture, as well as in one where the leading constraints arise from natural and landscape features. It is explicitly stated that the study was conducted under conditions as close as possible to those of the real spatial planning process, without being part of an official procedure for developing or

amending GDP, which in turn implies the acceptance of certain restrictions. The approach to selecting experts when applying the AHR method is justified.

The implementation of the methodological guidelines is demonstrated step by step. The territorial filters for identifying the eligible territories for the construction of a PPP are defined. At Stage 2, the DPSIR framework model was applied at a conceptual level to agricultural lands from 7th to 10th land category and non-categorizable lands, defined as territorially eligible for the location of PPPs at the GDP level. At Stage 3, a hierarchically organised system of criteria and sub-criteria was created for assessing the environmental sustainability of the territorially eligible territories for the construction of PPP in agricultural lands, planned at the GDP level. Based on the DPSIR analysis, six main criteria and corresponding sub-criteria are defined for assessing the environmental sustainability of these territories. At Stage 4, the AHP method is applied to determine the relative importance of each of them within the framework of the multi-criteria assessment. At Stage 5, in view of the balance between analytical validity and practical applicability, a selection of assessment indicators is made at the GDP level, which are valued at Stage 6. At the next stage, the assessments are normalized, and on their basis an Integrated Index of Environmental Sustainability is calculated for each of the considered alternatives. The results obtained were then ranked and interpreted. Based on the testing carried out, recommendations are proposed for improving the zoning regulations when planning PPPs on agricultural lands.

The work includes 6 appendices with a total volume of 33 pages. These appendices show 20 figures and tables, tracing the technology of the obtained research results.

The Summary of PhD Thesis follows the scheme of the Dissertation in a summarized form. It is presented on 53 pages. It is illustrated by 5 tables and 6 figures, and reflects the main points of the research carried out.

3. Relevance of the research problem

Renewable Energy Sources (RES) play a key role in sustainable development efforts, as they offer solutions that can reduce dependence on carbon sources and support the transition to a low-carbon economy. In the context of these global aspirations, the ecological approach to the planning and development of renewable energy projects (REP) is emerging as an important issue in science and practice. Its use means that already at the stage of spatial planning, environmental constraints and the sensitivity of the territory are taken into account, so that the construction of REP minimizes the impact on nature and society. Instead of searching for locations solely according to technical or economic criteria, an integrated approach is used, including various criteria. In this context, the topic has the potential not only for theoretical contribution, but also for proposing a practical tool to support spatial planning decisions.

4. Literary awareness and theoretical preparation of the candidate

For his dissertation, the author has analysed 135 literature sources, of which 65 are in English, and 6 are online sources of spatial and statistical data. In the proposed thesis, he has demonstrated serious knowledge and capabilities for using modern methods and tools to solve a current problem.

5. Methodical approach

The methods chosen to achieve the set goal combine theoretical, analytical and applied research. They include collection, systematization, processing and an analysis of scientific literature, regulatory documents, strategic and planning documents, spatial data and expert information. An experimental approach is also applied on real territorial alternatives in order to test the proposed

methodology. The municipalities of Radnevo and Rakitovo have been chosen to test the developed methodological guidelines. Their choice was motivated by the need to test the methodology on territories with different natural, geographical and socio-economic characteristics. Both municipalities allow to monitor the applicability of the preliminary territorial filtering, the DPSIR analysis and the subsequent multi-criteria assessment under different territorial conditions.

6. Significance and persuasiveness of the results obtained

The presented dissertation intrigues with its versatility and the experimental material. The topic is worth developing a PhD work and is well defined. The analysis of the literary sources is thorough and balanced. Competence and knowledge of the subject are demonstrated. The methodological framework is based on the application of an ecological approach in spatial planning, which considers the territory as a system of interconnected ecological, socio-economic and spatial elements. The author has successfully coped with both the theoretical justification and the experimental work. An additive approach to analysis and assessment is proposed, which for each object and time can be refined and upgraded, including a criterion aspect.

In terms of its volume and content, the presented material contains all the components of a dissertation. The experimental part is completed. The contribution part of the development is focused on the scientific direction 5.7. "Architecture, Civil Engineering and Geodesy", scientific specialty "Land Management and Conservation of Agricultural Lands (incl. Property Management)".

7. Assessment of the dissertation scientific contribution

I accept the conclusions and contributions proposed by the doctoral student as a result of her research and analysis. In my opinion, they can be summarized as:

- The need to coordinate the accelerated use of renewable energy with spatial planning by applying a comprehensive model of territorial planning for solar power plants on agricultural lands is justified.
- An integrated ecological approach for spatial planning of PPP on agricultural lands is proposed. The approach logically combines the principles of the ecosystem approach, the concept of ecosystem services, the DPSIR framework and multi-criteria assessment using the AHP method and can support spatial decisions.
- In implementation of the integrated ecological approach, a methodology for assessing and selecting territorial alternatives for solar power plants has been developed, including territorial restrictions, a hierarchy of criteria and sub-criteria, indicators, assessment scales, normalization of values and an integrated index of ecological sustainability defined by the author.
- The developed methodology has an adaptive nature, which allows its further development according to the territorial conditions, available data and the specifics of the set development task, while maintaining the general analytical sequence. The preliminary filters, criteria, indicators and expert weights are refined according to the specific objects.
- The applicability of the developed methodology for assessing, comparing and selecting territorial alternatives at GDP level as an analytical tool for substantiating and supporting the process of making planning decisions has been approved by testing two municipalities with different territorial characteristics.
- A variant of a production planning zone for the production and storage of electricity from a PPP has been proposed, with the relevant planning rules and norms, determining the conditions for limiting soil sealing, preserving soil functions, dismantling and reclamation of the territory after cessation of activity.

8. Assessment of the quality of scientific publications reflecting the results in the dissertation

The PhD student has presented three scientific publications that reflect a significant part of the dissertation. Two of them are self-published in the journal of "Geodesy, Cartography, Land Management" and one is in English in co-authorship, where she is the first author, reported at the Conference "E-Governance and E-Communications" (EGEC)" and published in the Conference Proceedings. In this way, the candidate meets and exceeds the minimum requirements for the number of points in group G8. 50 points were achieved with a minimum of 30 required.

9. Critical notes and recommendations to the PhD student

1. The contributions are correctly formulated, but I believe that their number can be reduced from 7 to 4 by combining contributions 1 and 2, combining contributions 3 and 4, and dropping contribution 6. The first and second contributions are meaningfully complementary and are transitional to the rational results of the dissertation work, namely the methodology for evaluating and selecting location alternatives for FPPs, given the value and strategic importance of the agricultural territory. Contributions 3 and 4 describe a methodology in various aspects, including criteria, sub-criteria, indicators and assessment scales to achieve the above-described goal. The activities described in Contribution 6 are necessary for validating the compiled methodology and cannot claim to be a contributing scientific part.
2. Given the universality of strategic spatial planning, including agricultural territory, I believe that the work has the potential to be further developed and used not only in our country, but also in other countries. In this context, I would recommend seeking an opportunity to present the research results in Journals with IF/SJR (e.g. Land Policy, etc.), through which it can reach more scientists and specialists in the field.
3. The sum of the coefficients in the penultimate column of the Pairwise Comparison Table of the Core Criteria of Level 1 in Appendix 3 should be 1.
4. It is necessary that the titles, objectives and conclusions in the publications accompanying the dissertation correspond more precisely to their content. For example, the first article lacks a conclusion regarding the impact of European Green Energy Policy on spatial planning, while the title makes a serious claim for this.
5. I positively assess the development of the doctoral student's publication skills, but the bibliographic references in the dissertation publications are missing pages where they are found in the literary editions, which is a requirement for all citation styles and which makes it easier for the reader to search for them.
6. It is not correct to include in the literary references the author's related to the topic of the dissertation publications (literary sources No. 31, 114). The latter present the results of the dissertation, and are not a source of information for its development.

10. Personal impressions of the candidate

I know the PhD student from her student bench. She has always impressed me as a serious, intelligent and ambitious young person with motivated interests and behaviour. Here I include her desire for in-depth knowledge, a critical attitude towards her own and students' educational process and consistency in the implementation of personal and common goals in the field of science. When performing assigned tasks both as a scientist and as a teacher, she shows dedication and surprises with her creative solutions. She actively participates in the organizational life of the University too.

CONCLUSION

The notes and recommendations made do not belittle the knowledge and skills demonstrated by the PhD student, but are rather recommendations for her future scientific activity. The presented dissertation, in terms of its research volume, content and contribution, fully meets the requirements of the Law on the Development of the Academic Staff of the Republic of Bulgaria (LDASRB), the Regulations for its implementation, and UACEG regulations for the implementation of the LDASRB and I give it an overall POSITIVE assessment. The basis for this assessment is the achieved goal, the demonstrated knowledge, the use of a modern methodological approach, technical and software tools and the results obtained.

Date: 24.08.2026
Sofia

Member of the Scientific Jury:
(Prof. Milena Moteva)