REVIEW

of the official opponent Volodymyr Petrovich Pasternak, doctor of agricultural sciences, professor, chief researcher of the department of forest inventory, monitoring, certification and forest management Ukrainian research institute of forestry and forest melioration named after G.M. Vysotsky,

for PhD thesis **Yan Tengfei** «The features of agroforest ecosystems and their impact on the environmental indicators of Chushandian reservoir's buffer strips», Submitted for a scientific degree of a Doctor of philosophy

Field of knowledge: 20 – Agricultural sciences and food

Specialty 201 – Agronomy

Relevance of the dissertation topic. Increasing demand for food and decreasing land resources have called attention to the importance of soil conservation and soil health. Currently, landowners and farmers are increasingly realizing agroforest ecosystems' benefits, and are implementing agroforestry practices for production, conservation, social, and economic benefits. Adopted agroforest ecosystems in riparian buffer zone is an important means for sustainable agriculture with a long history, yet not received enough attention. While adopted agroforest ecosystems in riparian buffer zone requires extreme caution, as they also carry important ecological functions such as water purification and sediment interception. Therefore, a comprehensive understanding of the environmental performance and economic productivity of adopted agroforest ecosystems in the riparian zones is important for the development and promotion of such measures.

Connection of the research with scientific programs, plans, and topics. The dissertation research was conducted within the framework of the project of Scientific Research Plan of Training Techniques for Key Teachers of Xinyang Agriculture and Forestry University "Vegetation succession and soil physicochemical properties in the riparian zone of Chushandian Reservoir" (215003). Part of the research was carried out within the framework of the project of Xinyang Ecological Research Institute Open Fund "Soil carbon sequestration potential and microbial drive mechanism of the typical reservoir's buffer strips in Huai River Catchment".

The scientific novelty of the obtained results. *For the first time*, a comprehensive survey was carried out in order to generalize the state of development and the application potential of the existing agroforest ecosystems in the buffer zones of the Chushandian reservoir; the ecological effectiveness of such factors as soil properties, soil aggregate stability, changes in carbon stocks, vegetation biodiversity, and microbial community structure for adapted agroforest ecosystems in the reservoir's buffer strips was investigated; the main factors affecting the ecological efficiency of adapted agroforest ecosystems in the specified research region were

analysed. The economic potential of these adapted agroforest ecosystems has been established. The understanding of the ecological efficiency of adapted agroforestry ecosystems has improved.

The expediency of creating adopted agroforest ecosystems in the protective strips of the reservoir is *substantiated*. Measures to increase economic efficiency and preventive measures for organic farming in adapted agroforest ecosystems in the buffer zones of the reservoir are *recommended*.

The practical significance of the obtained results. The thesis provides strong evidence of the feasibility of adopted agroforest ecosystems in the buffer zones of the reservoir. The author proved that adopted agroforest ecosystems in the buffer zone of the reservoir have an advantage in increasing the biodiversity of vegetation and maintaining species population. The author established that adopted agroforest ecosystems in the reservoir's buffer strips can maintain soil vitality, support higher microbial activity of the soil, improve the riparian habitat quality and increase the carbon storage potential in the soil. The author found that adopted agroforest ecosystems in the reservoir's buffer strips can maintain stable soil structure, regulate carbon stock change. The results of thesis confirms that adopted agroforest ecosystems in reservoir buffer strips can improve microbial diversity, maintain stable community structure, and enhance microbial metabolic activity. The thesis shows that adopted agroforest ecosystems in buffer zones of the reservoir can support stable economic income. The author recommends that farmers pay attention to strengthening the management of the drive areas to improve the quality of the soil and maintain the productivity of the land.

The main results obtained personally by the author. The dissertation provides a comprehensive theoretical framework and production suggestions for adopted agroforest ecosystems in the riparian zones. By investigating and analyzing the vegetation community structure, soil physicochemical properties, soil aggregate stability, microbial community species composition and ecological process of adopted agroforest ecosystems in the reservoir's buffer strips, the author discussed that adopted agroforest ecosystem in the reservoir's buffer strips has the potential to maintain vegetation diversity and productivity, improve the soil environmental quality of habitat, enhance soil carbon sequestration, maintaining the stability of soil structure and improving the diversity and metabolic activity of soil microbial community, proved the feasibility and ecological environmental advantages of adopted agroforest ecosystems in the riparian buffer zone.

Finally, by investigating the yield and economic output of adopted agroforest ecosystems in the reservoir's buffer strips, the author proves that adopted agroforest ecosystems in the riparian zone can maintain stable economic income. According to the environmental performance of agroforest ecosystems, the management measures and precautions of adopted agroforest ecosystems in the riparian zone are proposed.

It is worth noting that a plagiarism analysis for the presence of text borrowings (Strike plagiarism program) was carried out. The reviewers concluded that Yan Tengfei's dissertation work "The features of agroforest ecosystems and their impact on the environmental indicators of Chushandian reservoir's buffer strips" is the result of independent research of the PhD candidate and does not contain elements of plagiarism and borrowing following the resolution of the CMU dated 12.01.2022 No. 44 p. 9. Ideas, results, and texts of other authors used in the research paper have references to the corresponding sources.

The main provisions of the dissertation are presented in 16 scientific works, 3 articles in specialized publications of Ukraine, 2 articles in journals included in the scientometric databases Scopus and Web of Science, 1 article in a publication of other countries, the rest – abstracts of reports at international scientific and practical conferences and symposia. The materials of the articles and abstracts of reports reflect the main provisions and conclusions of the PhD thesis.

In the introduction, the dissertation justified the relevance of the topic of the work, formulated the aim and objectives of the research, reflected the scientific novelty and practical value of the chosen topic.

In the first chapter, based on the results of processing and study the world's scientific developments regarding the features and environmental performance of adopted agroforest ecosystems in reservoir's buffer strips different aspects of agroforest ecosystems are analysed, in particular relationship between vegetation buffer strips and agriculture; environmental performance of vegetation buffer strips and soil physicochemical properties.

In the second chapter, the short characteristics of Study area are reflected; the methods of field investigation and laboratory analysis are given. The analysis of the applied methods shows that they are adequate to the set goal and tasks and were correctly used during the research. The data were processed using statistical methods. The methods of synthesis, comparison and analysis were used to generalize the research results.

The third chapter devoted to the assessment of the vegetation biodiversity for adopted agroforest ecosystems in reservoir's buffer strips. Based on the results of research, it was determined that different land-use types have a greatly influence on vegetation agroforest ecosystems and some capacity to maintain the stability of vegetation community structure. It was also found that agroforest ecosystems can support more plant species, even including some shrubs, which indicated that adopted agroforest ecosystems in the reservoir buffer strips can promote more plant productivity.

In the fourth chapter, the soil properties for adopted agroforest ecosystems in reservoir's buffer strips author confirmed the critical role of distance from the watercourse on the heterogeneity of soil physicochemical properties in the buffer strips, both at large and fine

distance scales. Adopted agroforest ecosystems have obvious advantages over other land-use types in maintaining soil microbial activity, and promoting soil carbon sequestration potential, reducing Greenhouse gas emissions. Therefore, these ecosystems in the reservoir's buffer strips have strong operability and showed obvious environmental performance advantages. Meanwhile, the width setting of the reservoir's buffer strips should be appropriately increased (>20 m) in the case of restoration grassland and abandoned cropland. Soil microbial activity can be used as an important indicator for monitoring the soil nutrient status of different land-use types in the reservoir's buffer strips. However, these results were based on short-term preliminary investigations, and long-term monitoring of the coupling and decoupling mechanisms between soil physicochemical properties and vegetation needs to be carried out.

The fifth chapter dedicated to characteristic of soil aggregates stability and associated nutrient distribution for agroforest ecosystems in reservoir's buffer strips. Study is an important guide to designing and restoring the reservoir's buffer strips. In future reservoir buffer strip management, different protection measures and width settings should be adopted for different land-use types, and high priority should be given to the protection of water reservoirs. As for adopted agroforest ecosystems in the reservoir's buffer strips, that it can improve the soil aggregates stability, prevent carbon loss, and maintain the stability of the shoreline.

The sixth chapter describes the composition of the microbocenosis and adaptation mechanisms for agroforestry ecosystems in buffer zones of reservoirs. The study results showed that the microbial community composition and distribution characteristic of abandoned cropland and woodland were quite different at fine distance scales in the reservoir's buffer strips; the alternating dry-rewet shoreline environment promoted the microbial community metabolism-related function in different land-use types, especially in woodland, which implied the adopted agroforest ecosystems in reservoir's buffer strips had more stronger resilience to environmental alternation. Meanwhile, in terms of microbial community assembly mechanism, the stress from environmental alteration was the main pressure that shaped the soil microbial communities of different land-use types in the reservoir's buffer strips, and grassland usually have more resilience capacity to disturbance. Soil microbial community composition and distribution in the reservoir's buffer strips were the results of a combination of deterministic processes from environmental stresses and stochastic processes from the tolerance ability of different habitats to the environment.

The seventh chapter is devoted to the assessment of yield and economic efficiency for agroforestry ecosystems in buffer zones of reservoirs compared with traditional farming practices. Adopted agroforest ecosystems in the reservoir's buffer strips can still maintain relatively higher net income and have great potential for development.

The **conclusions and recommendations** summarize the results of the research and provide recommendations for implementing biological control measures, organic farming and improving the level of management. Adopted agroforest ecosystems in the reservoir's buffer strips can maintain high vegetation biodiversity, prevent carbon loss, improve soil carbon sequestration potential, increase soil infiltration, enhance microbial activity and ensure soil health and quality. The objectivity of the conclusions and recommendations given in the dissertation is confirmed by the actual material of the experimental part of the research.

Evaluation of the language and style of the dissertation. The dissertation is written in English clearly and correctly, with the use of many diagrams and photographs that facilitate the perception of experimental data. The presentation of research results in the work is logically connected, and the obtained data are well argued and accessible for perception.

Compliance of the dissertation with the specified specialty and requirements. The PhD thesis is a completed scientific work and fully meets the established requirements for design. The dissertation fully corresponds to the field of knowledge 20 "Agrarian sciences and food" specialty 201 "Agronomy".

Discussion clauses and remarks to the dissertation. Positively evaluating the dissertation work of Yan Tengfei, emphasizing its important scientific, theoretical, and practical significance, novelty, and relevance of the research, it is necessary to dwell on the following shortcomings, remarks, and comments:

1. The second chapter based on its content would be better to name the object and method of research.

2. It the table 5.1, it is necessary to indicate the specific meaning of the letters and name the first column.

3. Page 89, 95, it is necessary use italics for the letter p; the same problem exists for β (Page 122).

4. Table 5.2, the R square, it is better superscript and also the factors that have the greatest impact are highlighted in bold to make the results clearer.

5. The author's statement that adopted agroforest ecosystems can inhibit greenhouse gas emission has a certain theoretical basis, but it still needs more data to support.

6. In Chapter 7, the currency unit of economic income is RMB, which is recommended to be converted to US dollars.

7. It is impractical to highlight points 7.1.1 and 7.2.1, since they are the only ones in the subsections.

General conclusion. The PhD thesis of Yan Tengfei entitled "The features of agroforest ecosystems and their impact on the environmental indicators of Chushandian reservoir's buffer strips", which was submitted for defence to the specialized academic council for obtaining the

degree of Doctor of Philosophy in the field of knowledge 20 – "Agricultural sciences and food" in the specialty 201 – "Agronomy" in terms of its relevance, scientific and theoretical level, main results of validity, main provisions and results published in professional publications, and novelty of the setting and practical significance meets the requirements of the order of the Ministry of Education and Science of Ukraine No.40 dated January 12, 2017 "on approval of requirements for registration dissertation" and the Degree of the Cabinet of Ministers of Ukraine dated January 12, 2022 No.44 "On approval of the Procedure for awarding the degree of Doctor of Philosophy and cancellation of the decision of the one-time specialized academic council of the higher educational institution, scientific institution on awarding the degree of "Doctor of Philosophy" with amendments made according to the Resolution of the Cabinet of Ministers No.341 dated March 03, 2022. The PhD candidate Yan Tengfei deserves to be awarded the scientific degree of Doctor of Philosophy in specialty 201 – "Agronomy".

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The signature is certified,
Scientific secretary of URIFFM, PhD Olexiy KOBETS
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