REVIEW

of the official opponent **Oksana Leonidivna Tonkha**, doctor of agricultural sciences, professor, The dean of Agrobiology faculty of the National University of Life and Environmental Sciences of Ukraine,

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 topic and the obtained results. Agroforest ecosystems is a widespread practice in the United States and Europe and is aimed at the optimal use of natural lands, their improvement and effective protection, and also has a significant positive impact on mitigating climate change.

Adopted agroforest ecosystems in the riparian buffer zones have been tried in the United States and Europe, and proved that it has the advantages such as soil and water conservation and increase carbon sequestration potential. However, due to this measure involves a multidisciplinary approach, the research on its specific environmental performance and agricultural economic productivity has not been systematically in-depth. A significant achievement of research (its highlight) is a deep analysis of soil microbiota for plots with different land use.

Therefore, the research in this direction can further deepen the understanding of adopted agroforest ecosystems in riparian buffer zone, and also provide theoretical support for the promotion and popularization of this measure.

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. The dissertation summarizes the feasibility and current research status of adopted agroforest ecosystems in the reservoir's buffer strips. The dissertation comprehensive studied the environmental performance of adopted agroforest ecosystems in the reservoir's buffer strips from the aspects of vegetation, soil properties, soil aggregate stability and microbial community structure and the main factors

affecting the ecological efficiency of adapted agroforest ecosystems in the specified research region were analyzed. The dissertation investigated and analyzed the yield and economic income of adopted agroforest ecosystems in the reservoir's buffer strips, and expounded the mechanism and potential of maintaining the economic income of adopted agroforest ecosystems in this region. In short, the dissertation broadens our understanding of sustainable agriculture developing in riparian buffer zones and provides theoretical support and practical framework for adopted agroforest ecosystems in the riparian buffer zones.

The practical significance of the obtained results. The expediency of creating adopted agroforest ecosystems in the protective strips of the reservoir is substantiated. Measures to increase economic productivity and preventive measures for organic farming in adopted agroforest ecosystems in the buffer zones of the reservoir are recommended. Adopted agroforest ecosystems in the reservoir's buffer strips have numerous environmental advantages, such as improving habitat soil quality, maintaining stable soil structure, increasing soil carbonse questration potential, and enhancing microbial community activity and metabolic potential. Adopted agroforest ecosystems in the riparian buffer zones can still generate stable economic income, and even have the potential to increase economic income under scientific management. Farmers should pay attention to reducing the use of phosphorus compounds and adopt organic farming practices, which are also environmentally friendly. Adopted agroforest ecosystems in the reservoir buffer zones not only does not have a negative impact on the ecology, but also can increase farmers' income, which is a sustainable agricultural model worth promoting in the future.

The most significant scientific results obtained by the postgraduate personally. The main scientific propositions and conclusions given in the dissertation work are logically justified and developed on the basis of multilateral research.

The research comprehensively expounded the ecological advantages and environmental performance of adopted agroforest ecosystems in the reservoir's buffer strips through the aspects of vegetation productivity, soil properties, soil aggregate stability and nutrient distribution and microbial community characteristics, and the results are compelling.

The research demonstrates the potential of adopted agroforest ecosystems in the reservoir's buffer strips can get stable economic income, which is attractive to agriculture producers.

Finally, the author puts forward suggestions on the management measures and precaution of adopted agroforest ecosystems in the reservoir's buffer strips for environmental management departments and agricultural producers.

An analysis of the plagiarism check report for the presence of textual borrowings was carried out (Strike program plagiarism). They came to the conclusion that the dissertation work

(Yan Tengfei) on the topic “The features of agroforest ecosystems and their impact on the environmental indicators of Chushandian reservoir’s buffer strips” is the result of the acquirer’s independent research and does not contain elements of plagiarism and borrowing in accordance with the resolution of the CMU dated 12.01.2022 No. 44, paragraph 9. Used ideas, results and texts of others authors have a link to the corresponding source.

Number of scientific publications. The main items of the thesis are presented in 16 scientific works: 3 articles in professional publications of Ukraine; 2 in the international scientometric citation databases Scopus and WoS; 11 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 studying global scientific developments regarding features and implementation agroforestry improvement, their impact on productivity and sustainability of ecosystems, in particular relationship between vegetation buffer strips and agriculture; environmental performance of vegetation buffer strips and soil physicochemical properties. A description of the land use of the Huai River, with which the study area is connected, is also given.

In the second chapter, the short characteristics of Study area are reflected, the methods of field investigation and laboratory analysis are given. The data were processed using statistical methods. The methods of synthesis, comparison and analysis were used to generalize the research results.

In the third chapter, indices of the vegetation biodiversity (Simpson, Shannon, Richness, Pielouindex) of three land-use types are presented. It has been proven that different land-use types have a greatly influence on vegetation biodiversity in the riparian buffer strips of Chushandian reservoir. The main plants in the riparian buffer strips are *Compositae*, *Roseaceae*, and *Gramineae*, and the phenomenon of single genus and species is obvious, and the community composition is simplified. The vegetation at 2 m distance from the watercourse was mainly annual plants. At 20 m, plant life gradually diversified, perennial plants generally increased, and trees and shrubs also began to increase. Research has established that as for agroforest ecosystems, the distance to the watercourse obviously was an ignored factor when considering management. While compare to abandoned cropland, the agroforest ecosystems seem to have some capacity to maintain the stability of vegetation community structure.

In the fourth chapter, The relationship between the soil physicochemical parameters and the biodiversity of vegetation in the buffer strips of the reservoir with three types of land use are presented. New ideas for understanding the ecological value of reservoir buffer strips and their agricultural use are presented. Valuable theoretical standards for the adopted agroforest ecosystems in the protective zones of the reservoir are substantiated.

The leading role of the distance from the watercourse on the heterogeneity of the physical and chemical parameters of the soil in the buffer strips has been proven. Adopted agroforestry ecosystems have obvious advantages over other types of land use for maintaining soil microbial activity and promoting soil carbon sequestration potential, reducing greenhouse gas emissions. The width of the buffer strips should be increased (>20 m) when restoring land with pastures or arable land. Microbial activity of the soil can be an important indicator for monitoring the state of nutrients in the soil of different land use types in the buffer strips of the reservoir.

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.

The size and parameters of adapted agroforest ecosystems for different types of land use must be taken into account when constructing a dam for effective management of the buffer strip. Agroforest ecosystems improve the stability of soil aggregates and store carbon, and support shoreline stability.

Especially the TC2 (silt-associated carbon content) was the importance for the carbon cycle for adopted agroforest ecosystems in the reservoir's buffer strips. Also, as the influence of water level fluctuation in nearwater area, we need to pay attention to this region.

The sixth chapter describes the composition of the microbocenosis and adaptation mechanisms for adopted agroforest ecosystems in the 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 stripshad more stronger resilience to environmental alternation. Soil microcoenoses for their various uses were evaluated using modern methods of analysis, the results are statistically substantiated.

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. Among

them, TC is the main driving factor affecting microbial community structure. Histogram of predicted soil microbial community function deserves for the special attention.

The seventh chapter is devoted to the assessment of yield and economic efficiency for adopted agroforest ecosystems in the reservoir's buffer zones compared with traditional farming practices.

The conclusions and recommendations summarize the results of the research and provide recommendations for implementing biological control measures and 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.

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 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. In chapter 2 "Research methodology" it would be necessary to carefully describe technological operations (cultivation, fertilization, plant protection, crop rotation, etc.) for each type of land use (cropland, grassland, woodland).

2. Since the soil microbiota is sensitive to environmental conditions, soil layer, anthropogenic influence, in section 2 it is necessary to indicate the approximate dates when the soil samples were taken and from which layer, the conditions of the year (deviation from the average annual indicators of the amount of precipitation and temperature).

3. The conclusion regarding the lower content of ammonium nitrogen and higher nitrate nitrogen under adopted agroforest ecosystems than other types of land use is not statistically proven due to the significant variability of these indicators and the error of the method.

4. It is preferable not to use the content of total phosphorus to analyze the phosphorus regime, it is better to analyze the content of mobile phosphates.

5. In the dissertation, “Chushandian Reservoir” was appeared so many time. It was recommended to use abbreviation, such as “CR”.

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,
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