

THEORETICAL BASIS AND INDEX SYSTEM OF CULTIVATED LAND CONSOLIDATION POTENTIAL EVALUATION

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Abstract: As a basic work in the field of land consolidation, land consolidation potential evaluation plays a vital role. It is not only a key component of the feasibility analysis of land consolidation projects, but also an indispensable basis for formulating land consolidation planning. In addition, land consolidation potential evaluation also provides a solid foundation for land consolidation zoning, project selection and arrangement of consolidation sequence. In this paper, we first reviewed and sorted out the research progress of the evaluation index system of cultivated land consolidation potential. Based on this, we further discussed the theoretical basis of cultivated land consolidation and various factors affecting the potential of cultivated land consolidation. The paper emphasizes that under the guidance of the concept of sustainable development, farmland consolidation is not only a simple land consolidation activity, but also a complex process involving the sustainable use of land. Therefore, the connotation of cultivated land consolidation potential should include improving the natural suitability, ecological rationality, economic effectiveness, technical feasibility and social acceptability of land. In view of this, the construction of cultivated land consolidation potential evaluation index system should comprehensively consider these aspects to ensure the comprehensiveness and accuracy of the evaluation.

Keywords: Arable land consolidation; Potential evaluation; Theoretical basis; Index system

1 INTRODUCTION

The concept of land consolidation first appeared in the law of the kingdom of Bavaria in 1886. Several European countries such as Germany, France and Russia carried out land consolidation practice earlier, and then Canada, Japan, South Korea, Yugoslavia, Hungary and other countries also carried out land consolidation [1-2]. The history of land consolidation in China can be traced back to the well field system in the ancient slave society [3], but the real sense of land consolidation in China was formally proposed and operated in the late 1990s. Marked by the establishment of the land consolidation center of the state land administration in 1998 and the launch of the first batch of land consolidation projects in 2001, the Chinese government will invest billions of yuan each year in the implementation of land consolidation projects, and the practice of land consolidation is being widely carried out throughout the country [2].

Land consolidation is the product of a certain regional social and economic development to a certain extent, which puts forward new requirements for land use. It is a new way for human to use land. Under the background of rapid socio-economic development and rapid population expansion, China's ability to ensure the development of land has encountered a bottleneck, with limited urban construction land and shrinking food supply. At the same time, land waste, land desertification and land pollution caused by extensive and irrational land use have further exacerbated the scarcity of land resources. As China's reserve land resources are limited by many factors, such as small quantity, poor quality, difficult reclamation and fragile ecological environment [4], the number of new land to be further developed is limited, which needs to tap the potential of the original land. As an effective way to effectively allocate land resources, promote efficient and rational land use and improve land supply capacity, land consolidation has played an important role in promoting the sustainable use and sustainable use of land resources, which came into being. Land consolidation refers to the process of comprehensively renovating, adjusting and reconstructing the land use status in a certain area according to the objectives and uses determined by the land use planning or urban planning by means of administration, economy, law and engineering technology, so as to improve the land utilization rate, production, living conditions and ecological environment [5]. Under the national conditions of China with more people and less land, while accelerating the process of industrialization and urbanization, it is undoubtedly a wise move to vigorously promote land consolidation by using China's land to feed the Chinese population and taking into account the triple goals of food, construction and environmental protection [6]. Article 41 of the land administration law of the people's Republic of China points out that the State encourages land consolidation, and the 2012 government work report of the State Council also focuses on strengthening land development, consolidation and reclamation. In 2012, the national land consolidation plan (2011-2015), prepared by the Ministry of land and resources in conjunction with relevant departments, was officially promulgated and implemented with the approval of the State Council. China's land consolidation practice is in full swing and in the ascendant.

In order to comply with the development trend of land consolidation and provide theoretical support for the practice of land consolidation, scholars at home and abroad have conducted many fruitful studies on land consolidation. Foreign research hotspots on land consolidation mainly focus on the causes of land consolidation [7-8], the evaluation of land consolidation project plan [9], the land allocation method in the process of land consolidation [10] and the evaluation of

land consolidation effect [11-12], while the research on land consolidation potential is less involved. Land consolidation potential evaluation is a basic work of land consolidation. It is an important part of the feasibility analysis of land consolidation projects and the fundamental basis for formulating land consolidation planning. It is also the basis for land consolidation zoning, land consolidation project selection and consolidation sequence arrangement. It is of great significance to carry out land consolidation potential evaluation research for reasonable and effective arrangement of land consolidation work. Many Chinese scholars have done a lot of research on the connotation [13], investigation [14-15], evaluation methods [16] and quantitative evaluation [17-19] of land consolidation potential, but systematic research on the evaluation index system of land consolidation potential is rare. At present, China's land consolidation is mainly concentrated in farmland consolidation and rural residential land consolidation. This paper mainly discusses the index system of farmland consolidation potential evaluation.

Cultivated land consolidation potential refers to the improvement of cultivated land comprehensive production capacity through the implementation of consolidation measures in a certain area under certain economic and technological conditions [19]. China is a vast country with different natural conditions and economic, social and technological conditions. The ways, directions and characteristics of land use vary greatly. The problems faced by land use and consolidation are also different. The standards of land consolidation in different regions are also different. The potential of land consolidation shows obvious regional differences. Because the factors affecting the potential of land consolidation are regional, diverse and complex, the index system for evaluating the potential of farmland consolidation is also diverse. Quchenxiao et al. Calculated the potential of cultivated land consolidation in Henan Province Based on the coefficient of cultivated land consolidation [20]. Wangqian and others selected four indicators of per capita new grain output, per capita new cultivated land, new grain output and new cultivated land coefficient to evaluate the potential of cultivated land consolidation in Lanzhou [21]. Gongjian and others built an index system to study the land consolidation potential of Baokang County in Hubei Province from three aspects: the gap between the theoretical per unit yield and the actual per unit yield of cultivated land, the increased effective area of cultivated land after consolidation, and the improvement degree of cultivated land production capacity after consolidation [22]. Fanjinmei and others believe that the two factors affecting farmland consolidation are the net increase in the number of farmland and the improvement in the quality of farmland [19]. However, wulianglin and others believe that besides the potential of "quantity" and "quality", under the background of building a modern agricultural system in China, we should pay more attention to the ability of farmland consolidation to improve the level of land scale. Based on this, we quantitatively evaluated the potential of farmland scale consolidation by using landscape pattern indicators such as topographic indicators, land resource abundance index, land patch area index, land patch shape index and land aggregation index [23]. Zhuyubi and others believe that building the evaluation index system of cultivated land consolidation potential needs to start from two aspects: endogenous and exogenous variables that affect the potential of cultivated land consolidation. Endogenous variables include the level of cultivated land use, the ability to improve the level of cultivated land productivity and the degree of improvement of cultivated land ecological environment. These are the theoretical potential of cultivated land consolidation. Exogenous variables include economic benefits, social needs, infrastructure supporting conditions and enthusiasm for cultivated land consolidation. These are the limiting factors that determine whether theoretical potential can be transformed into real potential [24].

In general, China has carried out a lot of research work on the potential of cultivated land consolidation, and has also carried out some work on its potential evaluation index system. The evaluation index system has gradually changed from a single index evaluation method to a multi index comprehensive evaluation method, and the evaluation index design has also changed from mainly increasing the number of cultivated land to paying equal attention to increasing the number of cultivated land, improving the quality of cultivated land and improving the ecological environment. Cultivated land consolidation is an extremely complex system engineering, so the index system for evaluating its potential should avoid being single and one-sided. At the same time, the evaluation of cultivated land consolidation potential in China is still in the exploratory stage. We should make it substantive and in-depth through the study of comprehensive and systematic evaluation index system and evaluation standards, so as to better serve the practice of land consolidation.

2 THEORETICAL BASIS OF CULTIVATED LAND CONSOLIDATION POTENTIAL

According to the actual work of farmland consolidation in China at present, the potential of farmland consolidation refers to taking a series of measures in terms of administration, economy, law and technology to consolidate the farmland and roads, ditches, forest networks, ridges, graves, sporadic construction land and unused land in a certain area in a certain period of time according to the overall land use planning, so as to improve the comprehensive production capacity of farmland. This comprehensive production capacity is reflected in the increase of arable land use rate and output rate, the increase of arable land available area, the improvement of ecological environment, the decline of production costs, the improvement of infrastructure and the optimization of property relations. According to the regulations for the preparation of land development and consolidation planning, China's arable land consolidation potential includes the reclamation of flat graves, filling ditches, scattered homesteads and all kinds of abandoned and idle land, the development of scattered unused land, the improvement of field roads, forest network supporting facilities, ditch reconstruction (changing underground canals, sprinkler irrigation, etc.) and the transformation of medium and low yield fields, so as to build modern high standard farmland and improve land utilization and output [25]. However, this is only the natural potential of cultivated land consolidation. Whether it can be turned into real potential and the size of it

are affected by capital, technology, location, social support and other factors. With the increasing population growth, land degradation and environmental problems, the sustainable use of land is the basic guarantee for China to achieve sustainable development strategy [26-27]. Land consolidation is an activity taken to eliminate the unfavorable factors in the original land use system in order to better meet human requirements for land in the process of land use. Land use system is a huge system composed of subsystems such as natural subsystem, ecological subsystem, social subsystem, economic subsystem and technical subsystem, which interact, interweave and penetrate each other. The irrationality of any subsystem will affect the whole body and affect the overall function of land. Under the concept of sustainable development, land consolidation is not a temporary expedient, but an important project to achieve the strategic goal of sustainable development of land resources [28]. Therefore, the potential of cultivated land consolidation is the degree of implementing cultivated land consolidation activities to achieve natural suitability, ecological rationality, economic effectiveness, technical feasibility and social acceptability. The connotation of cultivated land consolidation potential can be understood from the following aspects.

2.1 Natural Suitability

Land consolidation is a systematic arrangement of the current situation of land use, and its process involves a detailed investigation of the types, quantity, structure, quality, distribution and existing problems of various land resources to be renovated. Through this process, the aim is to eliminate the limiting factors in the process of land use, so as to enhance the production potential of land. In view of the differences of land restrictions in different regions, as well as the inherent characteristics of fixed location, quality differences, diminishing returns and the relative difficulty of changing the direction of land use, the land consolidation work must design the most appropriate land use mode according to the actual situation of each region. For example, in the hilly area with large slope, in order to prevent soil erosion, it should be reduced to transform it into terraced fields, and returning farmland to forest is the most appropriate land use strategy in this area. The core of land consolidation is to eliminate unreasonable land use patterns, reduce the limiting factors of land use, and make rational allocation according to the inherent characteristics of land resources.

2.2 Ecological Rationality

Ecological rationality refers to that the land use system can achieve a good operation state in terms of ecology, ensure that land use will not destroy the normal ecological process, and make the key ecological processes such as water cycle, nutrient cycle, energy flow and biological migration fully and reasonably carried out. From the course of human development, we can clearly see that any land use practice must pay enough attention to ecological factors, which is the key to ensure the sustainable use and protection of land resources. Therefore, land consolidation activities should not only eliminate the negative factors that may affect the ecological function of land, but also actively explore and implement various methods to improve the overall ecological operation function of land, so as to achieve ecological rationality.

2.3 Economic Effectiveness

Economic benefits constitute the core driving force of land consolidation activities, and the benefit of its input and output is the primary goal of farmland consolidation. Only when the economic benefits of farmland consolidation exceed its cost input can the farmland consolidation project be sustainable. At the same time, if farmland consolidation can produce more significant economic benefits, it can stimulate the enthusiasm of the society for farmland consolidation activities, and then attract more capital investment to ensure the sustainable development of farmland consolidation activities.

2.4 Technical Feasibility

With the continuous progress and rapid development of science and technology, those cultivated land resources that were once considered to be unable to be effectively utilized have now been fully developed and utilized. This not only reduces the various restrictive factors faced in the use of cultivated land, but also significantly improves the resistance of cultivated land to drought and flood disasters, and ensures the stability and reliability of food production. The feasibility of technology is not only reflected in the cultivated land itself, but also includes the improvement and upgrading of related roads, ditches and infrastructure. In addition, the land leveling work, the rational consolidation of fields and the optimization and adjustment of land use structure are important components of technical feasibility. They work together to make the use of land resources more efficient and scientific.

2.5 Social Acceptability

With the continuous growth of population, the pressure on land resources is increasing, which leads to the continuous reduction of per capita cultivated land area. At the same time, the decline of grain self-sufficiency has also become a problem that can not be ignored. These factors work together, making farmland consolidation particularly urgent and necessary. Farmland consolidation is not only a technical activity, but also involves many people and interest groups, whose interests and demands are often complex. If the plan and action of land consolidation cannot be widely accepted

and supported by the society, it will be difficult to carry out this work smoothly. Therefore, improving production capacity, improving living conditions, optimizing landscape layout and realizing the rational distribution of land resources are the key factors that affect the acceptance of the masses and interest groups on farmland consolidation. Only by achieving balance and progress in these aspects can we ensure that the farmland consolidation work is recognized by the society and implemented smoothly.

3 ANALYSIS OF INFLUENCING FACTORS OF CULTIVATED LAND CONSOLIDATION POTENTIAL

3.1 Analysis of Influencing Factors for Improving Natural Suitability

When making use of cultivated land, we must fully consider the natural endowment of the region and adopt the strategy of adjusting measures to local conditions according to the actual local conditions. The thickness of cultivated land, the content of organic matter and the depth of groundwater will have a direct impact on the growth and production of different crops. For example, the land with thick tillage layer and rich organic matter content is more suitable for planting crops that need deep soil and rich nutrients, while the place with shallow groundwater depth may be more suitable for planting crops that are resistant to water and moisture. In addition, slope and elevation are also the limiting factors that can not be ignored in the use of cultivated land. The land with large slope is prone to water and soil loss, while the area with high elevation may be restricted by climate conditions. Therefore, in order to pursue advantages and avoid disadvantages, we need to reasonably adjust the land use structure and field scale structure to ensure the efficient and sustainable use of land resources.

3.2 Analysis of Factors Affecting Ecological Rationality

The factors that affect ecological rationality are actually those that can affect key ecological processes such as water cycle, nutrient cycle and energy flow. These factors include but are not limited to water and soil conservation rate, vegetation coverage, biodiversity, farmland shelterbelt area, farmland shelterbelt access index, basic farmland protection rate, landscape optimization degree and various facilities for disaster prevention and control. Specifically, the level of soil and water conservation rate is directly related to the degree of soil erosion and the loss of surface water, while the vegetation coverage reflects the lushness of surface plants and the health of the ecosystem. Biodiversity is a key indicator of ecosystem stability and stress resistance, which involves species richness and niche diversity. The area and accessibility index of farmland shelterbelts reflect the spatial distribution of shelterbelts and their ability to protect farmland. The protection rate of basic farmland is directly related to food security and agricultural sustainable development. Landscape optimization degree is related to the beauty of ecological landscape and the coordination of ecological functions. Finally, various facilities used to prevent and control disasters, such as flood embankment and drainage system, are important means to ensure ecological security and reduce the loss of natural disasters.

3.3 Analysis of Factors Affecting Economic Effectiveness

When discussing the connotation of cultivated land consolidation, it is not difficult to find that the economic effectiveness of cultivated land consolidation is mainly reflected in two aspects: the first is the significant increase in the effective use area of cultivated land, and the second is the significant increase in the yield per unit of cultivated land [19]. Specifically, the factors affecting the increase of the effective use area of cultivated land include the reduction of the proportion of ditches, roads and ridges. The optimization of these factors can effectively improve the utilization rate of cultivated land, so as to increase the effective use area of cultivated land. In addition, the increase in the number of new cultivated land is also an important factor to promote the increase in the effective use area of cultivated land. As for the factors affecting the increase of per unit cultivated land output, they include the concentration of fields, the degree of contiguity of fields, the degree of flatness of fields and the average scale of fields. By improving the quality of these aspects, it can effectively promote the increase of unit cultivated land output, and then enhance the economic effectiveness of cultivated land consolidation.

3.4 Analysis of Influencing Factors for Improving Technical Feasibility

An important goal of farmland consolidation is to create high-quality farmland that can resist drought and flood disasters. Therefore, the technical factors affecting farmland consolidation include many aspects. First of all, the size of irrigated farmland area is directly related to the production capacity and drought resistance of farmland. A larger irrigation area helps to improve the overall agricultural output. Secondly, the degree of flood control and drainage is a key technical index to ensure that farmland is not affected by floods in the rainy season, which involves the construction and maintenance of drainage system. In addition, the accessibility of field roads is very important for the entry and exit of agricultural machinery and the transportation of agricultural products. A good road network can significantly improve the efficiency of agricultural production. Motor well density is an important index to measure the convenience of farmland irrigation, which affects the irrigation frequency and efficiency of farmland. The connectivity of drainage channels and water conservancy facilities are also factors that can not be ignored. They ensure that the farmland can timely and effectively remove ponding in the rainy season and prevent crop damage caused by excessive ponding.

3.5 Analysis of Influencing Factors of Increasing Social Acceptability

As an important means of land management, land consolidation is gradually rising with the sustainable development and progress of social economy. Generally, when the economic development level of a region reaches a certain height, people's demand for rational allocation and efficient use of land resources will become more urgent. Therefore, as an important way to improve land use efficiency and output, the acceptance of cultivated land consolidation is often in direct proportion to the level of local economic development. With the further development of economy, the urgency and participation of the masses in farmland consolidation will also increase accordingly. In addition, the adequacy of land consolidation funds and government policy support and guidance are important factors affecting the social acceptability of land consolidation. Only when these conditions are met can the land consolidation work proceed smoothly and achieve the expected results.

4 ESTABLISHMENT OF EVALUATION INDEX SYSTEM OF CULTIVATED LAND CONSOLIDATION POTENTIAL

Land consolidation potential assessment is an activity to comprehensively evaluate the improvement of natural suitability, ecological rationality, economic effectiveness, technical feasibility and social acceptability based on the detailed investigation of the types, quantity, structure, quality, distribution and existing problems of various land resources to be consolidated and combined with the future land use mode. In view of China's vast geographical scope and the different natural conditions, economic, social and technological conditions in different regions, there are significant differences in the mode, direction and characteristics of land use, which makes the problems faced by land consolidation vary, and the land consolidation standards are also different, resulting in significant regional differences in land consolidation potential. Therefore, the construction of rural land consolidation potential evaluation index system should take the regional situation - land use status - land use objectives - factors affecting rural land consolidation potential - rural land consolidation potential evaluation index - evaluation criteria as the logical main line. When setting the evaluation index, we must follow the regional principle, comprehensive principle, scientific principle, operability principle and sustainability principle, and build the evaluation index system of rural land consolidation potential from the five dimensions of natural suitability, ecological rationality, economic effectiveness, technical feasibility and social acceptability according to the connotation of cultivated land consolidation potential.

4.1 Selection of Natural Suitability Index

The index reflects the adaptability of farmland consolidation activities to local conditions, and it is the natural potential of land consolidation in specific regions and natural conditions. Relevant indicators include field size, thickness of cultivated layer, organic matter content, groundwater depth, slope index and elevation index.

4.2 Selection of Ecological Rationality Index

The index reflects whether the farmland consolidation activities follow the ecological principle, which is the ecological potential of land consolidation without destroying the local natural environment and maintaining regional ecological security. Relevant indicators include soil and water conservation rate, vegetation coverage, biodiversity index, farmland shelterbelt area index, farmland shelterbelt access index, basic farmland protection rate, pollution prevention and control rate, natural disaster prevention and control rate, and landscape optimization degree.

4.3 Selection of Economic Effectiveness Index

The indicators reflect that farmland consolidation activities reduce production costs and increase land output, so as to achieve good economic benefits, which is the economic potential of land consolidation. Relevant indicators include new cultivated land coefficient, new grain coefficient, field concentration index, field contiguity index, field leveling index, average field size index, and input-output rate.

4.4 Selection of Technical Feasibility Index

The indicators reflect the potential achieved by the implementation of farmland consolidation with existing technologies. Relevant indicators include effective irrigation area index of cultivated land, flood control and drainage degree, field road accessibility, well density index, drainage channel connectivity index, and water conservancy facility connectivity index.

4.5 Selection of Social Acceptability Index

Indicators show the degree of external support for the smooth implementation of farmland consolidation activities. Relevant indicators include local economic development, population, average grain yield per unit area, investment in land consolidation, local government support, and farmers' participation.

In view of the availability of the above indicators and the differences in natural conditions, socio-economic conditions and ecological environment among different cultivated land consolidation areas, this study fully considered a variety of

factors affecting the potential of cultivated land consolidation. Among the many potential influencing factors, the key factors that can reflect the potential of local cultivated land consolidation were selected, and then the evaluation index system of cultivated land consolidation potential adapted to the local actual situation was constructed. Then, the evaluation indexes were quantified (the core is the determination of threshold), and finally the weight of each index was determined to calculate the potential value of cultivated land consolidation.

5 CONCLUSION

Many factors have an impact on the potential of rural land consolidation. When evaluating its potential, we should not only pay attention to its theoretical potential, but also fully consider the constraints that restrict its transformation into real potential. The construction of rural land consolidation potential evaluation index system should take the regional situation, land use status, land use objectives, factors affecting rural land consolidation potential, rural land consolidation potential evaluation indexes and evaluation standards as clues, and under the guidance of the concept of sustainable development, comprehensively consider the multiple functions of the land use system, so as to clarify the connotation of cultivated land consolidation potential, which should cover the potential of natural suitability, ecological rationality, economic effectiveness, technical feasibility and social acceptability. Based on this, this paper constructs the evaluation index system of cultivated land consolidation potential from the five dimensions of natural suitability, ecological rationality, economic effectiveness, technical feasibility and social acceptability. When constructing the evaluation index system, it is necessary to quantify each index to ensure the objectivity and operability of the evaluation process.

Secondly, the construction of the evaluation index system should follow the principles of scientificity, systematicness, comparability and dynamics. Scientificity requires that the selection of indicators must be based on the in-depth study of theory and practice; Systematicness emphasizes that the indicators should be interrelated to form an organic whole; Comparability requires comparability of indicators in different regions and time points; Dynamic means that the index system should be able to adapt to land use change and policy adjustment, with a certain degree of flexibility.

In practical application, the construction and application of the evaluation index system need to be combined with the actual situation of the specific region. For example, for areas with rich land resources but low degree of development, we should focus on the natural suitability and ecological rationality of land; For areas with tight land resources and dense population, more attention should be paid to the economic effectiveness and social acceptability of land. In addition, as the key factor to realize the potential of land consolidation, the evaluation standard of technical feasibility should also be adjusted according to the technical development level and actual operation ability of the region.

To sum up, the construction of rural land consolidation potential evaluation index system is a systematic project, which needs to comprehensively consider various factors and carry out personalized design in combination with regional characteristics. The scientific and reasonable evaluation index system can provide strong support for land consolidation planning and decision-making, and promote the sustainable use of land resources.

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REFERENCES

- [1] Hongquan G, Lei W, Jinmei F, et al. Multi-factor comprehensive evaluation model for the potential of arable land consolidation for Yanqing District in Beijing. *Transactions of the Chinese Society of Agricultural Engineering*, 2006, 22(8): 83-86.
- [2] Cao X, Zhang Q, Shang G, et al. Evaluation and classification of rural residential land consolidation potential in Hebei Province. *Transactions of the Chinese Society of Agricultural Engineering*, 2009. DOI: 10.3969/j.issn.1002-6819.2009.11.059.
- [3] Zou X, Luo M, Su W, et al. Spatial decision support system for the potential evaluation of land consolidation projects. *WSEAS Transactions on Computers*, 2008, 7(7): 887-898. DOI: 10.1016/0140-1971(89)90077-8.
- [4] Wang J, Ge A, Li C, et al. Fuzzy decision tree system for potential evaluation of land consolidation. 2015.
- [5] Shi L. Evaluation of potential development land remediation of Xialiang town in Zhashui county. 2015. DOI: 10.1201/B19126-168.
- [6] Li J, Zhao Y, Fu X, et al. The Potential Evaluation of Hilly Land Consolidation Based on Remote Sensing. *International Conference on Remote Sensing. IEEE*, 2012. DOI: 10.1109/RSETE.2012.6260781.
- [7] Zhang Q M, Yuan C F, Li X H, et al. The reconsolidation potential division of rural residential land in rapid urbanization area//*International Conference on Frontier of Energy and Environment Engineering*. 2015.
- [8] Qian W, Xue-Lu L. Integrated evaluation on the cultivated land consolidation potential of Lanzhou by entropy weight method. *Journal of Gansu Agricultural University*, 2009.

- [9] Li D. The Optimal Zoning of Non-Grain-Producing Cultivated Land Consolidation Potential: A Case Study of the Dujiangyan Irrigation District. *Sustainability*, 2024, 16. DOI: 10.3390/su16177798.
- [10] Xiao P, Zhao C, Zhou Y, et al. Study on Land Consolidation Zoning in Hubei Province Based on the Coupling of Neural Network and Cluster Analysis. *Land*, 2021, 10. DOI: 10.3390/land10070756.
- [11] Wang J, Ge A, Hu Y, et al. A fuzzy intelligent system for land consolidation – a case study in Shunde, China. *Solid Earth Discussions*, 2015, 7(2): 1347-1374. DOI: 10.5194/se-6-997-2015.
- [12] Roberts R S. An evaluation of agricultural lands for acquisition and consolidation : the Umatilla Indian Reservation. *Umatilla Indian Reservation*, 1976. DOI: <http://hdl.handle.net/1957/43714>.
- [13] Zhang M, Wang X, Zhang Z, et al. Assessing the Potential of Rural Settlement Land Consolidation in China: A Method Based on Comprehensive Evaluation of Restricted Factors. *Sustainability*, 2018, 10(9). DOI: 10.3390/su10093102.
- [14] Wu L, Luo J, Li M. Evaluation method of land-scaled consolidation potential based on landscape pattern principle. *Transactions of the Chinese Society of Agricultural Engineering*, 2010, 26(2): 300-306. DOI: 10.1080/00949651003724790.
- [15] Zou X, Li D. A multidisciplinary GIS-based approach for the potential evaluation of land consolidation projects: a model and its application//WSEAS International Conferences. 2008. DOI: <http://dx.doi.org/>.
- [16] Liu Y, Kong X, Zou Y. Evaluation model of cultivated land potential on different modes of land consolidation of rural residential areas. *Geomatics and Information Science of Wuhan University*, 2011, 36(9): 1124-1128. DOI: 10.1007/s12583-011-0162-0.
- [17] Zou X, Luo M, Su W, et al. Spatial decision support system for the potential evaluation of land consolidation projects. *WSEAS Transactions on Computers*, 2008.
- [18] Yubi Z, Chengshu L. Study on Index System of Potential Evaluation in Land Consolidation—A Case of Chongqing. *Chinese Agricultural Science Bulletin*, 2006.
- [19] Jin-Mei F, Xian-Su M, Yong-Sen X. A preliminary study on China's arable land readjustment potential evaluation: a case of Yanqing county in Beijing. *Geographical Research*, 2004, 23(6): 736-744. DOI: 10.3321/j.issn:1000-0585.2004.06.003.
- [20] Chen R, Zhang F, Meng Y, et al. Estimation of realistic potential of land consolidation in rural residential areas. *Transactions of the Chinese Society of Agricultural Engineering*, 2009, 25(4): 216-221.
- [21] Xuesong K, Yanfang L, Yafeng Z, et al. Potential Supply of Cultivated Land under the Land Consolidation of Rural Residential Areas Based on GIS. 2010 International Conference on Internet Technology and Applications, Wuhan, China. 2010, 1-4. DOI: 10.1109/ITAPP.2010.5566086.
- [22] Zou Y, Liu Y, Kong X. Study on Calculation of Rural Residential Land Consolidation Potential at County Scale. International Conference on MEMS, NANO and Smart Systems. 2012.
- [23] Cai Y, Zeng Y, Li D. A Web-Based Decision Support System for Evaluation of Benefits of Land Consolidation in China. 2006. DOI: 10.1109/SKG.2006.17.
- [24] Kaifanga S, Chengtaia D, Yongaia S, et al. Comparative on Evaluation and Classification of Rural Residential Land Consolidation Potential Based on Entropy Weight Method and AHP —A Case Study of Yongchuan District, Chongqing City. *Journal of Agricultural Mechanization Research*, 2012. DOI: 10.1111/j.1467-8500.2006.00485.x.
- [25] Yang G, Chen F Y, Guo C C. Calculation and Evaluation of Construction Land Reduction Potential Based on Correction Model. International Conference on Information Science, Computer Technology and Transportation. 2017.
- [26] Yu Q, Yan X, Wang Q, et al. A Spatial-Scale Evaluation of Soil Consolidation Concerning Land Subsidence and Integrated Mechanism Analysis at Macro-, and Micro-Scale: A Case Study in Chongming East Shoal Reclamation Area, Shanghai, China. 2021.
- [27] Guanghui J, Xinpan W, Wenju Y, et al. A new system will lead to an optimal path of land consolidation spatial management in China. *Land Use Policy*, 2015, 42: 27-37. DOI: 10.1016/j.landusepol.2014.07.005.
- [28] Liu Y, Guo L. Zoning and consolidation strategy for rural residential land in the areas around Bohai gulf in China. *Nongye Gongcheng Xuebao/Transactions of the Chinese Society of Agricultural Engineering*, 2011, 27(6): 306-312. DOI: 10.3969/j.issn.1002-6819.2011.06.054.