Evaluation of comprehensive economic, ecological and social benefits of land improvement projects

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Abstract. With the rapid development of urbanization, a large number of arable land resources have been occupied, the amount of arable land has fallen sharply, and food security issues have become prominent. In order to protect arable land resources and ease the pressure on land use, the role of land improvement has become increasingly prominent. Objectively evaluating the implementation effect of land improvement projects is a prerequisite for sustainable use and development of land resources. The article expounded three aspects of the role and development process of land remediation projects, the necessity of land remediation benefit evaluation, and an overview of land remediation benefit evaluation methods.

1. The role and development of land improvement projects

Land remediation is a single-time activity, which was completed in accordance with specific remediation objectives, investment budgets, and quality standards and will produce social, economic, and ecological benefits to the project area. The Land Consolidation Center of the Ministry of Land and Resources defines a land consolidation project as the subject invests a certain amount of funds through the establishment of an operating agency, in a certain area, according to the principles of sustainable use, and according to the goals and uses determined by the overall land use plan, adopt administrative, economic, legal and engineering and other technical means to comprehensively improve land, water, roads, forest villages, etc., adjust land use conditions, improve land utilization and output rates, and improve production and land ecological environment [1].

From the Notice of the Central Committee of the Communist Party of China and the State Council on Further Strengthening Land Management and Practically Protecting Cultivated Land to the Land Management Law amended in 1998, China has been developing land remediation for more than 20 years, and its connotation has been continuously expanded. Land remediation has become a social development enterprise with a large amount of investment, a wide range of influences, and a far-
reaching impact, and has achieved remarkable achievements. The Third Plenary Session of the Seventeenth Central Committee of the Party called for large-scale implementation of land remediation, and land remediation was gradually incorporated into the strategic layout at the national level in 2008. The proposal of the Central Committee of the Communist Party of China on the thirteenth five-year plan for national economic and social development proposed promoting large-scale farmland water conservancy, land improvement, low- and medium-yield farmland reconstruction and high-standard farmland construction in 2015 [2]. The above incident fully illustrated that land remediation was coordinating human-land relations, adjusting land use structure, ensuring national food security, comprehensively improving rural production, living conditions, promoting the transformation of agricultural development methods, improving land production capacity, protecting and optimizing the ecological environment, and promoting urban and rural overall development important supporting role. Land remediation was one of the core contents of land use and management at this stage and will continue for quite a long time. It was the basic way to practice the strictest cultivated land protection system and the strictest land conservation system [3]. It was important for regional development to give full play to the social role of land improvement.

2. The Necessity of Land Improvement Benefit Evaluation
The initial purpose of implementing land improvement was to implement the national balance of cultivated land occupation and compensation. The policy task of occupied and replenished cultivated land for non-agricultural construction was forcing a large amount of cultivated land resources and a sharp decrease in cultivated land during the process of urbanization. And food security issues highlight the pressure on the response to the protection of cultivated land resources [4]. With the further implementation of land improvement, the problems of pursuing an increase in the amount of cultivated land and neglecting the improvement of cultivated land quality, focusing on light construction and protection, neglecting ecological environmental protection, and disconnecting project construction from farmers needs have also become increasingly prominent, affecting the sustainable use of land resources and development [5]. Therefore, a reasonable evaluation of the implementation effect of land remediation will help summarize the experience and lessons and promote the healthy development of land remediation.

The benefit of land improvement was one of the important contents to check the pros and cons of the implementation of the project, and it can also provide scientific decision and effective technical support for the implementation and management of land improvement. The core of land improvement benefit evaluation was the determination of the evaluation content and evaluation method, and the determination of the evaluation content depends on the definition of the land improvement benefit connotation. Therefore, the analysis of the land improvement benefit connotation was the basis of land improvement benefit evaluation [6]. The benefits of land remediation projects include not only solid form outputs, but also intangible outputs, which are manifested in whether the land remediation function system was realized, such as economic efficiency, social equity, public satisfaction, and ecosystem improvement. Taken together, it was still mainstream to start from the three dimensions of traditional economic, social and ecological benefits [7-8]. The benefit of land improvement is the unity of social, economic and ecological benefits. The pursuit of ecological and environmental benefits was the basis and premise of land remediation, social benefits were the purpose of land remediation, and the pursuit of economic benefits were the central content of land remediation and the vitality of land remediation.

3. Overview of Evaluation Methods for Land Remediation Benefits
The evaluation of land improvement benefits was an activity for subjective purposes. It was relative to a certain value standard to judge whether the evaluation result was good or bad. In order to achieve the purpose of evaluation, the selection of its evaluation indicators, standards, scales and dimensions were subjective, which means that when implementing the benefit evaluation of land improvement projects, the evaluation subjects need to determine the evaluation indicators, standards, scales and dimensions
by themselves. Pursue the objective and scientific nature of the evaluation; the concept of land improvement benefits differs depending on the stage and dimension. Therefore, the evaluation of land improvement benefits was dynamic. When implementing the evaluation, different evaluation methods need to be adopted for different stages, different dimensions, and different scales.

The analysis and evaluation of land improvement benefits is one of the core and focus contents of post-evaluation of land improvement projects. Different scholars at home and abroad have carried out multi-faceted research on the connotation, index system, and evaluation methods of land improvement benefits from different perspectives, and have achieved land improvement Project benefit evaluation changes from a single economic benefit to a comprehensive benefit evaluation, a combination of quantitative and qualitative changes to a comprehensive quantitative evaluation [9-10]. At the same time, there are also inconsistencies in evaluation indicators and lack of comparison of evaluation results in different regions. Most studies only evaluate specific projects, and the horizontal (different regions) and vertical (different time periods) studies of the effect of land remediation from a regional perspective Less, and more focus on the content, indicators, methods and technical system research of the implementation effect evaluation of specific projects at the micro-scale, the impact mechanism and factor analysis of land improvement benefits are less, which leads to problems such as insufficient scientific basis for macro decision-making on land improvement.

The evaluation method was the foundation and guarantee for the evaluation of land improvement benefits. In order to better meet the actual conditions of land improvement, foreign experts have introduced a multidisciplinary comprehensive evaluation method into the evaluation of land improvement benefits [11]. Huylenbroeck borrowed a multidisciplinary approach to build a comprehensive planning and evaluation framework for land consolidation projects, and applied the approach to case studies in Flanders and Portugal [12]. Coelho proposed a system model for land consolidation benefit evaluation, and carried out empirical research using the Valenca project in northern Portugal as an example [13]. At the same time, some scholars discussed the evaluation criteria for land consolidation benefits. Sklenicka designed the plots based on plot size, plot shape, plot location, natural and social conditions, economic benefits, and landlord's consolidation advantages Pre-project evaluation and post-project evaluation, including two sets of criteria, and empirical research in three different regions of the Czech Republic [14].

3.1. Economic Benefit Evaluation of Land Remediation
At the beginning of land remediation, the project focused on the evaluation of the economic benefits of the project. Noort calculated the economic benefits of the land consolidation project based on the labor return rate of farmers [15]. Buján et al. proposed to compare the “lot dispersion” before and after reorganization, the benefits of reducing the time cost of agricultural transportation due to the improvement of the road network [16]. Wang et al. pointed out that the static investment assessment method reflects the time value of money through the study of the current land consolidation economic benefit evaluation methods [17]. Using empirical analysis, contrasting dynamic and static investment assessment methods, the investment evaluation method was used to evaluate land consolidation. Zhang et al. divided the economic benefits of land remediation into direct economic benefits and indirect economic benefits [18]. For the direct economic benefits, the annual net incremental output value of the unit area after consolidation, the net incremental output value of the effective area at the end of the planning period, and the cumulative net incremental output value, unit area were selected. Two indicators of relatively saved land and working days after land consolidation were selected to quantify the economic effects of land consolidation. The research results generally show that land consolidation can effectively improve the economic benefits of land use and farmers' labor returns.

3.2. Evaluation of social benefits of land improvement
Due to the wide-ranging impact of social benefits, it was difficult to directly measure them. Scholars have argued more about the evaluation scope and evaluation methods of social benefits of land consolidation. Frank also included the impact of land consolidation on urban construction and
development and land property rights into the social benefit evaluation system [19]. Deng et al. studied how to introduce social variables in the planning process of land consolidation projects, and provided ideas for social benefit evaluation of land consolidation projects [20]. Deng et al. screened changes in land utilization, new cultivated land rate, new cultivated land supporters, per capita cultivated land area change rate, agricultural income increase rate, and convenient rural roads from the perspective of macro social effects after the implementation of the land consolidation project [21]. The rate of change, the rate of change in agricultural labor productivity, the rate of change in land carrying capacity per unit area, and the rate of change in the degree of supporting infrastructure in farmland are evaluated using fuzzy model identification methods to evaluate the social benefits of land improvement projects.

3.3. Ecological Benefit Evaluation of Land Remediation
The ecological benefits of land consolidation projects are reflected through changes in land use and ecological landscapes. Sklenicka et al. researched three land consolidation projects in the Czech Republic and found that the small-area plaques were the smallest and the proportion of large-area plaques increased significantly [14]. Mihara conducted an in-depth analysis of the effects of soil and water conservation in rural land consolidation [22]. The results of the study showed that land consolidation can change the soil structure and reduce soil invasion. Zhao et al. evaluated the environmental benefits of land consolidation projects by designing landscape fragmentation indicators such as boundary density, shape index, average shape index and fractal dimension [23]. Zhao et al. proposed a three-level evaluation index system, evaluation model and related parameters for the ecological benefits of land improvement projects on the farmland scale, starting from the three aspects of cultivated land quality, ecological conditions, and environmental quality [24]. Li et al. constructed a land consolidation regional ecological and environmental impact assessment index system from five indicators including biological abundance index, vegetation coverage index, water network density index, land erosion index, and land suitability index. The dynamic indicators were compared before and after the implementation, and the regional eco-environmental condition index (EI) was calculated using the index sum method, and a relatively satisfactory evaluation result was obtained [25].

3.4. Comprehensive Benefit Evaluation of Land Improvement
The comprehensive benefit evaluation of land remediation was the coordination and unification of economic, social and ecological benefits. Shen believed that rural land consolidation was a means to achieve sustainable rural development, which can improve agricultural production, employment, infrastructure, public facilities, etc., and protect Natural resources [26]. Kuang et al. discussed the model of multi-objective analysis of land consolidation projects, and established the economics of land consolidation projects based on the analysis of the economic benefits, ecological benefits, social benefits, and constraints of coordinating these benefit objectives [27]. Qin et al. constructed an evaluation index system for comprehensive benefits of land improvement from four aspects: social, economic, ecological and landscape [28].

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