Countermeasures for China's Ecological Environment Construction in Land Reclamation

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Abstract Basic situation of the current ecological environment construction in land consolidation and rehabilitation of China is introduced. The related advanced experience abroad is summarized from mainly four aspects, namely policy, system as well as subject development, planning guidance, design method of project planning and engineering study, and practical countermeasures to China's ecological environment construction in land reclamation are proposed. In terms of policy, system and subject, relevant regulations, policies and system construction should be strengthened and the framework of policy, system and subject development in ecological landscape construction of China's land reclamation should be proposed, integrating ecological environment construction into land reclamation. At the level of strategic planning, the spatial layout and construction key points of green infrastructure in land reclamation of "urban multi-functional developing region, eastern economic developed region, central modern agricultural region and northwestern ecological fragile region" should be achieved. At the level of project planning design, ecological principles, sustainable landscape design principles and vernacular landscape design methods are to be integrated into the planning procedure to form operable technique regulations or introductions. At the level of engineering design, engineering technique system, standards and regulations of ditches, roads, forests and channels with local distinctions should be formulated according to the characters and strategic demands of urbanization, industrialization, agriculture modernization and ecological environment preservation in different regions.

Key words Land Reclamation, Ecological Environment Construction, Foreign Experience, Countermeasures

The primary task of land consolidation and rehabilitation, as a chief means of using and transforming nature during humans' developing process, was to increase grain production and decrease natural disasters over the initial stage, namely the early thousands of years of agrarian civilization. With the increasing improvement of economy and society, China has proposed newer and higher requirements on land reclamation and the emphasis of land reclamation should be transformed from quantities to the combination of quantities, qualities and ecological management[1]. At present, the countryside, agriculture and farmers in China are experiencing a profound reform. Firstly, free transfer of farmland contract authority and management rights promotes the transform of agricultural production to professional and scale operation. The current agricultural infrastructure is required to be upgraded comprehensively and systematically. And the technical problems of combining agricultural infrastructure with green infrastructure in rural land reclamation are urgent to be resolved. Secondly, strategy of rural and urban overall development and management system reform of rural collective construction land will largely release rural housing land. Besides, under the circumstance of current "village hollowing" and heavily damaged infrastructure like ditches, channels, roads and forests, the comprehensive regulation of hollow villages, rural housing land and farmland infrastructure needs new theories, planning methods and engineering technology. Furthermore, land reclamation polices require scale reconsolidation and rehabilitation, at least to be progressed in the whole village and town, which requires that land reclamation take the relationship between the spatial layout of ecological landscape with different scales (region, project and engineering) and ecological progress into consideration and improve the spatial planning of land reclamation as well as engineer versatility[2]. Therefore, researches on the key technology in ecological environment construction are urgent to be strengthened in land reconsolidation and rehabilitation.

1 Actual conditions of China's ecological environment construction in land reclamation

The successively issued *Land Development and Consolidation Planning Compilation and Regulation* (TD/T1011 - 2000), *Standard of Planning Design in Land Development and Consolidation Project* (TD/T1012 - 2000), *Acceptance Regulation in Land Development and Consolidation Project* (TD/T1013 - 2000) and *Village Planning Standard* (GB50188 - 93) in China all involve ecological environment construction in land reclamation. During "the eleventh five-year plan" period, some studies on site selection, planning design, project construction, quality and ecological monitoring and information technology of land reclamation project were carried out and required to be deeply studied. Besides, biological diversity preservation, rural landscape features and green infrastructure should be strengthened[3-4].

The officially replied *National Land Reconsolidation and Rehabilitation Planning* (2011 - 2015) first put forward the theory, method and technology study of ecological landscape construction in rural land reclamation systematically and comprehensively. The principle of "unification of land reclamation and ecological preservation" and the strategic goal of "promoting ecological environ-

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ment revolution and constantly improving ecological environment quality" are proposed. In " overall promotion of land reclamation", "establishing regional ecological security pattern, strengthening construction in core area, protecting and recovering natural environment pattern as well as maintaining the integrity of land ecological system" are proposed. "Ecological land reclamation mode is to be promoted in western area." "Strengthening ecological protection and recovery", "adapting to construction demands in major functional area, exerting ecological landscape function of farmland and improving regional ecological environment" are also suggested. "Preserving and recovering ecological environment should be the primary task in key ecological functional area and biodiversity should be preserved." To "largely promote farmland reclamation", "strengthening the landscape, ecology and leisure function of farmland" is proposed. "Ecological function of cultivated land is to be promoted in ecological fragile region". "Strengthening farmland protection as well as ecological environment construction" is emphatically proposed in order to enhance the quality of cultivated land. "Strengthening the protection of rural landscape features" is stressed in promoting the regulation of rural construction land. In regulation of town industrial and mining land, "increasing ecological land, strengthening protection of historical culture and preserving local distinctive landscape" are put forward. In quickening land reclamation, "stressing ecological environment protection and achieving the unification of land reclamation, land recovery, landscape construction as well as economic and social sustainable development" are clearly proposed. The implementation of those strategic goals and main points requires systematic and profound researches from different levels as well as theories, methods and engineering technology in strengthening ecological environment and landscape construction in an attempt to make practical achievement.

2 Foreign advanced experience of ecological environment construction in land reclamation

2.1 Policy, system and subject development Relevant regulations, policies and systems are constantly modified in various countries to integrate ecological landscape construction into the original system. A case in point is that America has repeatedly modified Agricultural Law and set the plan of farmland protection, rural nature conservation, waste land recovery, ecological network and green infrastructure construction. In system construction, Britain strengthens administrative leadership and supervision, distributes subsides to farmers and proposes license management. In view of biodiversity preservation and rural landscape construction, advanced management engineering is formulated and administrative measures on highlands and impoverished land are proposed. Besides, administrative units in Britain related to land management, land improvement and soil have changed their names with the addition of green, ecology, village and landscape. While, the Netherlands has always been in the leading position in the construction of subject system. For instance, institutes of soil and land utilization as well as land improvement and drainage have been merged to establish a green environment institute consisting of various research laboratories like rural development, biological diversity, ecological system service, landscape ecology, water and climate change as well as risk analysis and management. Subjects in schools of Wageningen University have been restructured and ecology, land, landscape as well as geographic information have become the main contents in subject improvement.

2.2 Planning regulation European countries formulated *Rural Community Design Regulation*, *Farmland and Forestland Design Guide*, *River Design Guide*, *Agricultural Buffer Zone Design Guide*, *Green Infrastructure Guide*. Related trade associations and institutes in Japan introduced *Environment and Landscape Design Technique*, *Rural Landscape Design Methods as well as Ecology and Habitat Regeneration Technology* as the essential guidance in rural landscape construction.

2.3 Project planning and design methods Over the time period between 2002 and 2009, Food and Agriculture Organization (FAO) held land reconsolidation and rehabilitation conferences several times. Various demonstration researches on land reclamation have been carried out especially in view of land fragmentation and devastation, village hollowing, ecological environment degradation, rural landscape damage and biodiversity decrease resulted from urbanization and land privatization after the reform in east European countries. The European Union has successively carried out cross-border researches throughout the Europe on ecological network, multi-function land utilization project, multi-function agricultural development and land reclamation. Project planning and design guide has been proposed especially in view of the recovery and management of abandoned agricultural land. America has carried out a large amount of researches on the relationship between water and soil resource management, contamination control in the basin area and land reclamation and effectively promoted the original planning and design of land reclamation project. In planning theories and methods, these countries has widely adopted those about ecological service function, biological diversity preservation, ecological system flexibility, sustainable landscape design, village design methods, green infrastructure construction, high-valued farmland, village ecology, esthetic indexes and participatory approach.

2.4 Study on engineering technology Japan proposed ecology and habitat recovery engineering of various types with the guidance of " nature regeneration method". Countries of the European Union proposed technical guide of rural ecological landscape project according to each characteristics. For instance, British rural land management and environment protection engineering guide involves 133 advanced management engineering techniques in view of biodiversity preservation and rural landscape construction. With the guidance of the Agricultural Law, America proposed nature and agriculture protection engineering standards which involved nearly 100 items and the extensive contents, covering not only all land reclamation engineering technology implemented currently in

China but also biological diversity preservation, rural landscape construction, abandoned land recovery, water pollution control and recreation road construction[6-9].

3 Strengthening countermeasures on ecological environment construction of China's land reconsolidation and rehabilitation

Developed countries, especially those of the European Union with a thick population, has gradually realized the significance of rural ecological landscape construction when the urbanization rate arrives at 50%. In urban and rural spatial planning, under the demand of urbanization and rural sustainable development, promotion of rural landscape features, preservation of historical and cultural heritage, biodiversity protection, water and soil security and rural leisure tourism should be given full consideration in an attempt to achieve green infrastructure and ecological security pattern of urban-rural integration.

3.1 Policy, system and subject Construction of relevant regulations, policies and systems in land reclamation should be strengthened and policy, system and subject development framework of ecological landscape construction in China'land reclamation should be proposed, integrating ecological environment construction into land reclamation system to achieve operable land reclamation. Besides, technical regulations of ecological landscape construction are to be strengthened and biodiversity preservation, rural landscape evaluation, ecological security pattern and quantitative method of ecological service function should be proposed to establish the theories and methods in ecological landscape construction and administration.

3.2 Strategic planning China has a vast land with uneven distribution of water and soil resources and there are marked differences in natural condition as well as social and economic situation among different regions. Industrialization and collectivization are obvious and basic farmland is relatively centralized in the eastern area. While, the central area shoulder the main task of grain production in China and the western area bears relatively fragile ecological environment. Therefore, each area requires different strategic demand and the applied key technology in land reclamation. At present, however, the integrated technology of ecological landscape construction according to different regional features has not been established. And the integrated system of ecological landscape technology in land reclamation based on distinctive regional characteristics are urgently needed to achieve the spatial layout and construction key points of green infrastructure in land reclamation of " urban multi-functional developing region, eastern economic developed region, central modern agricultural region and northwestern ecological fragile region" as well as perfect the strategic planning guide of ecological landscape construction combining the improvement of landscape features, preservation of historic and cultural heritage, water and soil security, biological diversity preservation and village recreation together.

3.3 Project planning and design Ecological principles, sustainable landscape design principles and rural landscape design methods are to be integrated into the planning procedure to form operable technical regulation or guide. Ecological landscape classification and evaluation, ecological process analysis and evaluation, ecology and habitat analysis and evaluation should be integrated into the planning design of land reclamation project. Besides, contents and methods of ecological landscape planning and design should be raised.

3.4 Engineering design With the present engineering knowledge and results at home and abroad, engineering technology system, standard and regulation with local characteristics should be established according to the features and strategic demands of urbanization, industrialization, agricultural modernization and ecological environment protection in different regions. How to achieve ecological landscape engineering system of recovering biology, saving resources, decreasing pollution and disturbance as well as promoting rural landscape culture and esthetic values during the designing process should be emphatically studied[10-13].

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