Land Reclamation Feasibility of Youfanggou Reservoir in Yilong County

Lili WANG *

College of Land and Resources, China West Normal University, Nanchong 637009, China

Abstract The large-scale development of reservoir resources has caused excavated land and deposited land, and the damage is quite serious; a large portion of damaged land is arable land. The arable land resources are limited in China, and land reclamation is an effective way to achieve "balance between occupying and compensation" for arable land and ensure basic arable land. Youfanggou Reservoir in Yilong County is a new reservoir, and after it is built, the temporary land needs to be reclaimed into original land. Based on the statistics about type and area of temporary land in four areas of Youfanggou Reservoir, this paper analyzes the reclamation feasibility, in order to provide a reference for the land use in the region.

Key words Youfanggou Reservoir, Temporary land, Land reclamation, Feasibility analysis

1 Overview of the study area

Yilong County is a county of Sichuan Province, China. It is under the administration of Nanchong City. Yilong is located in the northeast of Sichuan Basin, and the transitional zone between southern low mountains of Micang Mountain and hills of Central Sichuan[1]. It features a humid subtropical climate, with four distinct seasons. This county has Jialing River, Yilong River, Lushui River and Xiaoshui River, and it is also dotted with various water conservancy facilities such as Youfanggou Reservoir, Side Reservoir and Baisheng Reservoir. The water area in this county is more than 10000 ha[2]. Youfanggou Reservoir is a new reservoir in Yilong County, and the dam lies on Liujiang River in Biquan Township of Yilong County. The reservoir junction is situated in Youyi Village of Biquan Township, about 35 km away from downtown of Yilong County. Youfanggou Reservoir supplies water for Biquan Township, Laiyi Township, Rixing Town, Dafeng Township, Shuangqing Township and Wufu Town in Yilong County, irrigating 51000 mu of farmland. 938 people are resettled and the drinking water problem is solved for 120000 people. To fully implement the basic national policy of "cherishing land and effectively protecting farmland" and principle of "to hold those who cause damage responsible for reclamation", in March 2011, Ministry of Land and Resources issued *Land Reclamation Regulation* and a series of other regulations and standards, to regulate land reclamation activities, strengthen land reclamation management, and improve social, economic and ecological benefits of land use. The land reclamation activity in Youfanggou Reservoir is an example of reclamation in accordance with national requirements[5-6]. Land reclamation, usually known as reclamation, and also known as land fill (not to be confused with a landfill), is the process of creating new land from ocean, riverbeds, or lake beds. The land reclaimed is known as reclamation ground or land fill. It includes land remediation project, biological measures for land remediation, landscape ecological restoration, recovery of land ecosystem biodiversity, land quality, land production efficiency and benefit[5, 7-8]. Land reclamation program provides not only the basis of implementing the reclamation work, but also the funding for the reclamation work. It is also an important basis for the regulation of land and resources departments[7, 9]. During the project construction, excavation and wastes not only damage vegetation and land, but also cause new soil erosion, which will inflict some impact on regional ecological environment[10].

2 Data and methods

2.1 Data sources The data come from Yilong Bureau of Land and Resources. The bureau provides Land Boundary Survey Map of Youfanggou Reservoir in 2015, and Land Reclamation Report on Youfanggou Reservoir Project.

2.2 Data processing In Southern CASS mapping software, we open the Land Boundary Survey Map of Youfanggou Reservoir in 2015. It is divided into four parts: flooded area, affected area, junction area, canal system area. The types of land occupied are divided into agricultural land, construction land and unused land. With township as unit, the occupied land types for the four areas are statistically analyzed[4].

3 Results and analysis

Table 1 shows the land classification in Youfanggou Reservoir's canal system area in 2015. The land occupied by the canal system is temporary land, and in the process of building reservoir, the canal system type will also change. The canal system shifts from open channel to culvert with the completion of reservoir construction. During the shift, the land occupied needs to be reclaimed. In northeastern Sichuan, the climate is good, the annual rainfall is also abundant, and there is much arable land and woodland. Woodland generally does not need artificial irrigation. The land

Received: February 20, 2016 Accepted: April 28, 2016
* Corresponding author. E-mail: 448921651@qq.com

reclamation of transportation road also occupies a small part. As for the construction land, the main land occupied is residential land, and the farmers whose land is occupied will be resettled. For the reclamation of residential land, there is no need to reclaim it into the original land type. The unused land has no reclamation area. Flooded area is the area submerged beneath the waters during the reservoir construction, and from the land occupation for reservoir construction to the use of reservoir, this part is a part of permanent occupied land. Table 2 shows the land classification in Youfanggou Reservoir's flooded area in 2015. The flooded area has no land reclamation area, so the land reclamation in this paper does not consider Youfanggou Reservoir's flooded area. Junction area involves water conservancy facilities, drainage tunnel, spillway, water tower, generator room, reservoir management room, etc. after the building of the reservoir, and it is a permanent land acquisition area. Table 3 shows the land classification in Youfanggou Reservoir's junction area in 2015. From building to use, it will always be in a permanent state of land acquisition, without reclamation area. Reservoir construction must take into account the possibility of rising water level, and the affected area is a part affected after considering the rising water level, so the size of affected area will not change. Table 4 shows the land classification in Youfanggou Reservoir's affected area in 2015. The affected area is also a permanent land acquisition area, in no need of reclamation.

Table 1 Land classification in Youfanggou Reservoir's canal system area in 2015 Unit: ha

Canal system	Region	Agricultural land	Construction land	Unused land	Total
Main canal	Biquan Township, Yilong County, Nanchong City	0.5798	0	0	0.5798
	Rixing Town, Yilong County, Nanchong City	3.8599	0.0987	0	3.9586
	Shuangqing Township, Yilong County, Nanchong City	1.6283	0.0248	0	1.6531
Gaoban branch canal	Rixing Town, Yilong County, Nanchong City	0.2221	0.0196	0	0.2417
Shuangqing branch canal	Shuangqing Township, Yilong County, Nanchong City	0.2191	0	0	0.2191
Wufu branch canal	Shuangqing Township, Yilong County, Nanchong City	0.7234	0	0	0.7234
	Wufu Township, Yilong County, Nanchong City	0.9034	0.0150	0	0.9184
Total		8.1360	1.1581	0	8.2941

Table 2 Land classification in Youfanggou Reservoir's flooded area in 2015 Unit: ha

Region	Agricultural land	Construction land	Unused land	Total
Enyang District, Bazhong City	1.8581	0	0.0295	1.8876
Biquan Township, Yilong County, Nanchong City	53.6974	1.0358	0.3771	55.1103
Laiyi Township, Yilong County, Nanchong City	21.3692	0	0.2141	21.5833
Mengya Township, Yilong County, Nanchong City	7.9174	0	0	7.9174
Total	84.8421	1.0358	0.6207	86.4986

Table 3 Land classification in Youfanggou Reservoir's junction area in 2015 Unit: ha

Region	Agricultural land	Construction land	Unused land	Total
Biquan Township, Yilong County, Nanchong City	4.6556	0.1762	0.0188	4.8506
Laiyi Township, Yilong County, Nanchong City	0.8749	0	0	0.8749
Total	5.5305	0.1762	0.0188	5.7255

Table 4 Land classification in Youfanggou Reservoir's affected area in 2015 Unit: ha

Region	Agricultural land	Construction land	Unused land	Total
Biquan Township, Yilong County, Nanchong City	0.3588	0	0	0.3588
Mengya Township, Yilong County, Nanchong City	0.3726	0	0	0.3726
Total	0.7314	0	0	0.7314

4 Analysis of land reclamation feasibility

4.1 Effect on ecological environment In the process of building Youfanggou Reservoir, the excavation, waste, construction facilities and road construction will damage vegetation and slope stability, which could easily lead to soil erosion; at the same time, the building of reservoir will cause different forms of land damage. In general, the damage of reservoir building to land mainly includes excavation damage and occupation damage.

4.1.1 Excavation damage. Excavation damage means that the

building foundation excavation and filling as well as reclaiming in the stocking yard, destroys soil structure, fundamentally changes the initial conditions of soil nutrients, and increases the possibility of soil erosion and nutrient loss. If there are no prompt backfilling measures, pit will form and affect the normal growth of surrounding plants, and accelerate soil erosion and erosion rate. It is difficult to reclaim and plant, and plants are difficult to grow, which leads to soil erosion, ecological deterioration, land productivity decline and many other social and environmental issues[11].

4.1.2 Occupation damage. Occupation damage means that the temporary construction sites (such as material yard, warehouse, storage yard and construction camps) and construction roads occupy the land, and due to huge amount, myriad types and complex physical properties of solid, it will cause serious damage to the occupied land. Thus, the excavation damage and occupation damage in Youfanggou Reservoir are the main reasons for the damage to land during reservoir construction. If there are no appropriate measures for protection and there is no reclamation of the land temporarily occupied by the project after the completion of the reservoir construction, the topsoil will be washed away, and it can lead to soil nutrient loss, soil structural damage, barren land and wasteland, thus increasing the difficulty in the future control and greening work[12]. In the initial phase of land reclamation and ecological restoration, vegetation selection is essential. The temporary land use causes a moderate damage to dry land, woodland and pond, and there is no chemical pollution and other types of irreversible damage. Therefore, after the land reclamation is completed in the Youfanggou Reservoir construction, the effect on local ecological environment is small.

4.2 Suitability analysis of land reclamation

4.2.1 Original land use. The original land use types in Youfanggou Reservoir include dry land, woodland and ponds. The dry land damaged is reclaimed into the original land use type, which improves land utilization and maintains the function of original land use. The ponds damaged are reclaimed into paddy to meet farmers' living needs and increase crop yields. The woodland occupied is reclaimed into woodland, which is conducive to the restoration of ecological environment and soil erosion control, and is consistent with the land use types around.

4.2.2 Land damage. Youfanggou Reservoir project construction will excavate and damage local land, causing soil erosion and damage to land structure, so it is necessary to reclaim the land temporarily occupied by the project in order to prevent soil nutrient loss, barren land and wasteland. The dry land and paddy fields are determined as the direction of reclamation, which is conducive to the smooth implementation of reclamation project.

4.2.3 Natural conditions. Youfanggou Reservoir is located in the hilly regions of Yilong County, and the project area features a subtropical humid monsoon climate. There are no cold winters and hot summers. The annual average temperature is 17.6℃ and the accumulated temperature ≥10℃ is 4500℃; the rainfall is abundant, and the average annual precipitation is 1056 mm; the average annual evaporation is 1077 mm. It is humid and cloudy, the frost-free period is long, and heat is sufficient, creating good natural conditions for the land reclamation in Youfanggou Reservoir.

4.2.4 Socioeconomic conditions. The location of the project area is agricultural area, and the land occupied is dry land, woodland and pond, and the crops include rice, wheat, corn and so on. Crops are economic source of local residents, and to protect the interests of local residents and maintain their quality of life, the reclamation direction of this project gives priority to dry land and paddy fields.

4.2.5 National policies and regional planning. The land for Youfanggou Reservoir mainly includes arable land and woodland, and based on local conditions, it is necessary to consider the land use patterns and ecological restoration around the areas to be reclaimed, and reclaim the arable land and woodland to maintain consistency with the original land use patterns according to *Land Management Law of People's Republic of China* (2004), *Land Reclamation Regulations* (2011), *Land Management Implementation Measures of Sichuan Province*, *Sichuan Provincial General Land Use Planning* (2006 – 2020) and *Overall Land Use Planning in Nanchong City* (2006 – 2020).

4.2.6 The public wish. According to field research and public survey results, it is found that the local residents want the temporary land damaged in the four areas of reservoir (canal system area, flooded area, junction area, affected area) to be restored to arable land after the completion of reservoir project construction, without reducing crop yields. Therefore, it is necessary to take restoration and remediation measures for the damaged land, and avoid big changes in land functions, to protect the interests of farmers.

4.3 Constraints on land reclamation in Youfanggou Reservoir Firstly, there are some differences in the land occupation time during reservoir construction. The permanent land is occupied for a long time, while the temporary land is only occupied before and during the implementation of project, and it is immediately reclaimed after the use. Therefore, for the reclamation in the project area, it is necessary to take reclamation measures immediately after the completion of the project in order to restore the nature of land. Secondly, since the reservoir is in farming areas and the topsoil is removed before carrying out the project, there is a need to refill the excavated area after completion of the project. Before land reclamation, there is a need to dismantle the surface infrastructure. Therefore, in designing reclamation, it is necessary to clean up land, plow land and level land, to make the reclamation area restored to arable state.

5 Reclamation direction

According to the above reclamation suitability evaluation, the land reclamation direction, within the scope of responsibility for reclamation, is dry land, paddy fields and woodland, as shown in Table 5.

Table 5 Reclamation direction and land type area Unit: ha

Region	Reclamation direction			
	dry land	paddy fields	woodland	Total
Biquan Township, Yilong County, Nanchong City	0.0000	0.4442	0.1356	0.5798
Rixing Town, Yilong County, Nanchong City	0.1183	0.2221	3.8599	4.2003
Shuangqing Township, Yilong County, Nanchong City	0.0248	0.7892	1.7816	2.5956
Wufu Town, Yilong County, Nanchong City	0.0150	0.0223	0.8811	0.9184
Total	0.1581	1.4778	6.6582	8.2941

6 Conclusions

The damaged land reclamation and use in Youfanggou Reservoir can promote intensive land use, and achieve socio-economic and environmental sustainability, in line with national land management policies, which can provide a reference for land resource management and ecological restoration. 3.7165 ha of land is temporarily occupied in Youfanggou Reservoir, that is, the damaged land area is 3.7165 ha; the reclaimed land area is 3.7165 ha, with reclamation rate of 100%. Before reclamation, the reclamation area occupies 2.6681 ha of dry land, 0.9925 ha of woodland and 0.0559 ha of ponds; after reclamation, the overall structure of land use is changed. After the land-use nature of damaged temporary land is restored in Youfanggou Reservoir by taking reclamation measures, it will achieve good economic, social and environmental benefits. Therefore, from the perspective of land reclamation, the reclamation project is feasible.

References

[1] CHEN T, XU Y. Research on tourism development planning pattern of western county scale - A case of Yilong "twelve - five" tourism development planning[J]. Soft Science, 2013(8):141 - 144. (in Chinese).

[2] WANG WM. Institutional innovation and the development of rural microcredit: Research on the association for rural development of Yilong County of Sichuan[D]. Wuhan: Central China Normal University, 2009. (in Chinese).

[3] CHEN XX. The technical system of land reclamation based on land suitability assessment[D]. Beijing: Beijing Forestry University, 2009. (in Chinese).

[4] SHI P. Suitability evaluation on land reclamation of mining areas in Jilin City based on GIS[D]. Jilin: Jilin University, 2013. (in Chinese).

[5] WANG J. Study on land reclamation law[D]. Qingdao: Ocean University of China, 2008. (in Chinese).

[6] BAO JX, GE L, ZHANG X, *et al*. Land reclamation patterns of rural construction in Chongqing[J]. Agricultural Engineering, 2012:47 - 50. (in Chinese).

[7] WANG H, WANG P, XIE LX, *et al*. Commentary on methods for suitability evaluation of land reclamation[J]. Journal of Central South Forestry University, 2010:154 - 158. (in Chinese).

[8] ZHOU Y, BAI ZK, LUO M, *et al*. Problems and countermeasures of land reclamation regulatory system in China[J]. China Land Science, 2014:68 - 74, 82. (in Chinese).

[9] WANG DL. The technical system of land reclamation based on land suitability assessment[D]. Changchun: Northeast Normal University, 2012. (in Chinese).

[10] YANG YJ. The problems and countermeasures of land reclamation orogram implementation[D]. Beijing: China? University of Geosciences, 2010. (in Chinese).

[11] WEI Y, GU HB, XUE L, *et al*. Review of studies on reclamation and ecological restoration of abandoned land of mine[J]. Science of Soil and Water Conservation, 2012:107 - 114. (in Chinese).

[12] WANG L. Discussing the application of 3S technology for land reclamation in coal mine area: A case study of Zhenxing[D]. Taiyuan: Taiyuan University of Technology, 2013. (in Chinese).

(From page 53)

tion, fines, and taking back circulated land, to ensure agricultural use and high efficient use of agricultural land.

References

[1] China Net. Xi Jinping: The job should be taken by ourselves[EB/OL]. http://news.china.com.cn/2015 - 08/25/content_36410028.htm. (in Chinese).

[2] CAI RL, CHEN WM, ZHU XC. Costs and benefits: The internal cause of the non - food phenomenon of cultivated land transfer and the key solutions [J]. Rural Economy,2015(7):44 - 49. (in Chinese).

[3] YAO C, YU ZX, TANG H, *et al*. Construction of high - standard basic farmland and grain security[J]. Journal of Anhui Agricultural University (Philosophy & Social Sciences Edition),2013,03:1 - 5 + 77. (in Chinese).

[4] Xinhua Net. The grain should achieve continuous increase for twelve times [EB/OL]. http://news.xinhuanet.com/politics/2015 - 12/09/c_128511556.htm. (in Chinese).

[5] WU LC. Study on performance of grain subsidy policies from the perspective of farmers producing behavior[D]. Hangzhou: Zhejiang University,2011. (in Chinese).