Study on the quantity and quality potential of farmland consolidation and rehabilitation in county area

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***Abstract*—Land consolidation and rehabilitation is the important measure to achieve quantity dynamic balance and quality increase of farmland, and ecological environment improvement. At present, potential measure of farmland consolidation and rehabilitation in county area is the foundation of land consolidation and rehabilitation plan. On the basis of land change survey in 2010 of Huairou county of Beijing and farmland zones, the previous land consolidation and rehabilitation project results were used and combined with typical survey to calculate quantity potential. Meanwhile, the quality potential of farmland was calculated based on the results of farmland quality classification. Taking administrative villages as units, potential of county farmland consolidation and rehabilitation was analyzed and evaluated, and the research results can provide technical support for making land consolidation and rehabilitation plan in Huairou county.**

***Index Terms*—Potential of farmland consolidation and rehabilitation, typical survey, farmland quality classification, land consolidation and rehabilitation plan in county area.**

I. INTRODUCTION

Land is the important resource and material basis of survival and development of human beings. As the essence of land, farmland is the one of the basic elements that constitute the overall grain production capacity and guarantee to achieve food security [1]. Today, as the urbanism speeding up, farmland reduces increasingly, and strict protection becomes a top priority. Farmland protection is not only demand quantity stability, but also demand quality stability to achieve the stability of comprehensive production capacity [2]. In the new land consolidation and rehabilitation plan, renovation potential of farmland must be the foundation of making plan. Potential of farmland consolidation and rehabilitation, is to synthetically renovate land and the roads, forest tries, ditches, graves, sporadic construction land and unused land distributed in land, and has a certain potential in improving the quantity and quality of farmland, and playing agricultural scale benefits. Potential of farmland consolidation and rehabilitation involves quantity potential and quality potential 2 aspects. Some scholars had carried on related research on the quantity and quality potential of farmland consolidation and rehabilitation. Liu et al [3] adopted multi-factor weighting method to evaluate potential. Wang et al [4] had researched potential classification by constructing 3 indexes analysis model. Chen et al [5] calculated potential in factor combination method. Moreover, Liu et al [6] and Wang et al [7] adopted agricultural land potential productivity calculation results to analyze quality potential. Although related research methods are many, there are different degrees of subjectivity. On the basis of farmland classification, used the previous land consolidation and rehabilitation project results, combined with typical survey and used farmland quality classification results to calculate quantity and quality potential. In this way, the operation is more simply, the result is more accurate and more conform to reality. Also it can provide technical support for making land consolidation and rehabilitation plan in county area.

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II. RESEARCH METHODS

A. Study on the quantity potential

The quantity potential is increasing farmland area by planning and designing unused land which is suitable for farming and reduce the proportion coefficient of the roads, ditches and banks distributed in farmland [8]. In general, the potential comes from 2 aspects. One is from increasing land area by road-ditch-bank consolidation, the other is from adjusting farmland type on the basis of suitability evaluation.

Calculation of quantity potential is based on the land change survey figure of 2010, and classified farmland zones according to the slope. On the basis of farmland zones, through typical survey, calculated the area of roads, ditches and banks accounted for the proportion of the area of farmland in typical field. Then took the average of road-ditch- bank coefficient of typical fields as the road-ditch- bank coefficient of the corresponding farmland zone. Through calculating the difference of the road-ditch-bank coefficient between it of farmland zone and the standard coefficient that is the area of roads, ditches and banks accounted for the proportion of the area of farmland which in the same farmland zone with a higher level of intensive utilization, and determined the road-ditch-bank reduction coefficient of the

farmland zones. Results of road-ditch- bank reduction coefficient multiplied with the area of land for consolidation is the increased area comes from road-ditch-bank consolidation. At the same time, used on map measurement method to determine the area that fragmentary land can be adjusted as farmland. Sum of the 2 areas is the quantity potential of administrative villages. The roadmap of quantity potential calculation is shown in Fig. 1.

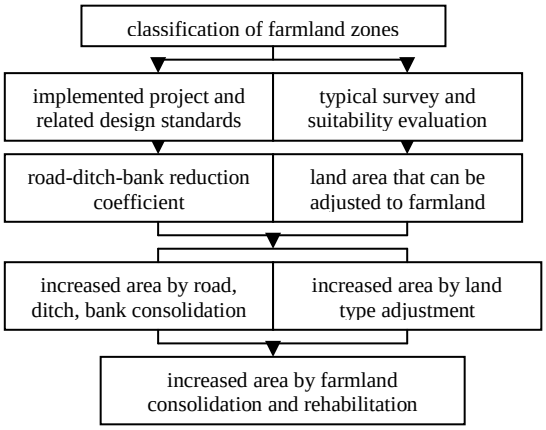

Fig. 1. Roadmap of quantity potential calculation

B. Study on the quality potential

The quality potential mainly comes from 2 aspects. One is from improving farmland infrastructures, the other is from transforming and eliminating the limiting factors in the cultivation. Some obstacle factors limited farmland playing production capacity, such as soil with thin layer, soil erosion, et al. Aim at eliminating the factors, implement a series of engineering and biological measures to improve quality grades.

The quality potential is mainly realized by improving the quality grades. Based on the achievements of farmland grades classification, took the grades average of units of each village as the grade of the village. Selected the highest grade of unit of town as the target that quality grade of villages can improve, and calculated the increased quality grade of village.

III. EMPIRICAL STUDY

A. The general situation of the study area

As a suburbs county, Huairou locates in the northeast of Beijing, and lies in 40°14'N-41°04'N, 116°17'E-116°53'E, 50 kilometers far from city center. With a temperate continental monsoon climate, winter is cold and dry, summer is heat and wet. Landscape is mainly mountain that accounting for 89% of the entire area, and geomorphic profile from south to north distributes in piedmont plain- Jundu mountain - intermountain basin - mountain pattern. There are 4 soil types - brown soil, cinnamon soil, tide soil and paddy soil, and pH is 5.9-8.0. As the important water supply source is of rich groundwater and fine water quality with numerous river and reservoir.

Farmland area of Huairou is 10208.64 hectare in 2010. The farmland mainly covers irrigable land, dry land, and vegetable land, which irrigated land accounts for 47.79%, dry land for 47.67%, and vegetable land for 4.54%. The farmland natural quality characteristic of Huairou is a decreasing trend from south to north. Farmland with high quality grade mostly distributes in southern plains, and farmland with lower quality grade mainly distributes in northern mountains.

B. Calculation of the quantity potential of the study area

1) •*Farmland zones classification:* Based on the land change survey figure of Huairou in 2010, taking administrative villages as units, farmland of administrative villages is divided into 3 types according to slope classification state. Slope below 6° (including 6°) belongs to flat farmland zone, in 6°-15° belongs to slope farmland zone, and above 15° belongs to hilly farmland zone.

2) •*Calculation of the increased potential by road-ditch-bank consolidation:* On principle of random selected several administrative villages to do typical survey. According to the zones selected typical plots and its area is required more than 2%-5% area of the corresponding farmland zone. The task is to measure and count the area of roads, ditches and banks distributed in typical field. Calculated the area of roads, ditches and banks accounted for the proportion of the area of farmland in different typical fields. According to the requirements of the standard plots in land consolidation and the field design standard that is derived from the implemented land consolidation projects, set standard road-ditch- bank coefficient of the farmland zone that is in the same zone with typical field with a higher level of intensive utilization. Then set 3 different road-ditch-bank coefficients in 3 farmland zones. In flat farmland zone, designed standard of field is shown in Fig. 2, the road-ditch- bank coefficient is about 8.5%. In slope farmland zone, designed standard of field is shown in Fig. 3, the road-ditch- bank coefficient is about 10.5%. In hilly farmland zone, designed standard of field is shown in Fig. 4, the road-ditch- bank coefficient is about 14.0%.

Calculated the area of roads, ditches and banks accounted for the proportion of farmland area through typical survey. The average coefficients of the typical fields were taken as the road-ditch-bank coefficient of the corresponding farmland zone. Then calculated the difference of the road-ditch-bank coefficient between it of farmland zone and the standard coefficient and determined the road-ditch-bank reduction coefficient of the farmland zone. Computation formula is shown in Eq.1.

$$\alpha_d = A_d - A_b \,. \tag{1}$$

α_d is road-ditch-bank reduction coefficient, A_d is road-ditch-bank reduction coefficient of each farmland zone, A_b is the standard coefficient which is in the same farmland type with a

higher level of intensive utilization. Calculation results are shown in TABLE Ⅰ.

According to the area of farmland that prepare for consolidation and the corresponding road-ditch-bank reduction coefficient, calculated the area increased by roads, ditches and banks consolidation. Computation formula is shown in Eq.2.

$$\Delta S_d = \alpha_d \times S \quad . \tag{2}$$

ΔS_d is the area increased by roads, ditches and banks consolidation, S is the area of farmland that prepare for consolidation.

TABLE I. ROAD-DITCH-BANK COEFFICIENT OF FARMLAND ZONE

farmland zone	flat farmland	slope farmland	hilly farmland
road-ditch-bank coefficient	8.92%	11.10%	15.38%
road-ditch-bank reduction coefficient	0.42%	0.60%	1.38%

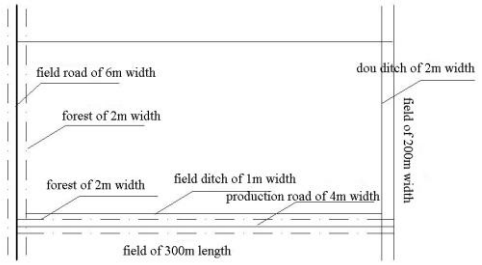

Fig. 2. Standard design of the flat farmland zone

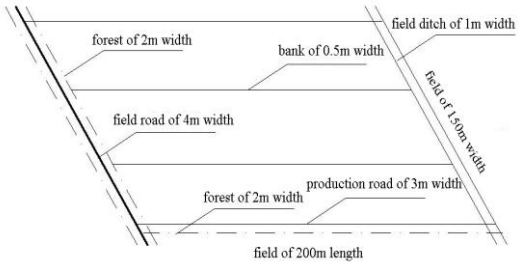

Fig. 3. Standard design of the slope farmland zone

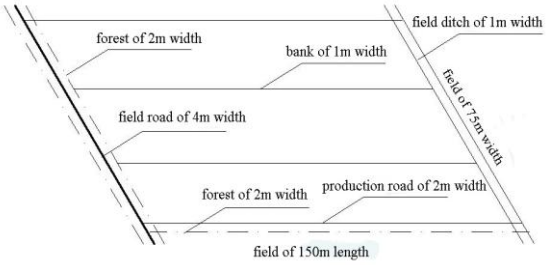

Fig. 4. Standard design of the hilly farmland zone

3) *•Calculation of the increased potential by land type adjustment:* Based on the suitability evaluation, used on map measurement method to determine the area of garden land, forest land, abandoned pits and sporadic construction land, calculated the increased potential by land type adjustment. Computation formula is shown in Eq.3.

$$\Delta S_q = S_q \times (1 - k) \quad . \tag{3}$$

ΔS_q is the farmland area increased by land type adjustment, Sq is the sum of the area of land that can be adjusted, k is the standard road-ditch-bank coefficient (in flat farmland zone subtracted as 8.5%, in slope farmland zone subtracted as 10.5%, in hilly farmland zone subtracted as 14.0%).

4) *•Calculation of the increased potential by farmland consolidation and rehabilitation:* Based on the land change survey figure of Huairou in 2010, the area of land to consolidation and rehabilitation is 10208.64 hectare. Counted the increased potential by road-ditch- bank consolidation and land type adjustment. Computation formula is shown in Eq.4.

$$\Delta S = \Delta S_d + \Delta S_q \quad . \tag{4}$$

ΔS is the farmland area increased by farmland consolidation and rehabilitation.

5) •Classification of the increased potential by farmland consolidation and rehabilitation: In "land development and consolidation plan key points at the level of provincial and county" issued by Land Planning Department of the Ministry of land and resources in 2002, taking the increased farmland area and increased farmland coefficient as the basis of classifying potential. So took villages as units and increased farmland area as basis, the increased potential by farmland consolidation and rehabilitation was classified into 4 grades. The increased area above 2 hectare is set as the first level, 0.5-2 hectare is the second level, below 0.5 hectare is the third level, and 0 hectare is the fourth level. According to the classification results, got the figure of quantity potential of farmland consolidation and rehabilitation with ArcGIS 9.3. Result is shown in Fig. 5. Can be seen from the figure, the first grade areas mainly distributes in Xigou, Yinhegou, Xifuying and other villages in northern mountains and Gengxinzhuang, Taoshan and other villages in plain with large area of farmland. This is consistent with the distribution of farmland in this area.

C. Calculation of the quality potential of the study area

1) *•Calculation of the improved grade:* Based on the results of farmland grades classification, took the grades average of units as the grade of the village. Selected the highest grade of unit as the target that quality grade of administrative village can improve, and calculated the improved quality grade. The farmland highest grade of each town is shown in TABLE Ⅱ.

2) *•Classification of the improved grades:* Take villages as units and improved quality grade as basis, the quality potential was classified into 4 grades. The improved grade above 2 grades is set as the first level, and 1-2 grades is the second level, below

1 grade is the third level, and 0 grade is the fourth level. According to the classification results, got the figure of quantity potential of farmland consolidation and rehabilitation with ArcGIS 9.3. Result is shown in Fig. 6. Can be seen from the figure, the first grade area mainly distributes in the 23 villages of Qiaozi Town, and Dayushu, Bochazi, Qifengcha, Yushuidong and other villages in northern mountains. Jiuduhe, Weidian and other middle hilly villages have bigger potential.

IV. CONCLUSIONS

Calculate the potential of farmland consolidation and rehabilitation scientifically is the foundation of county land consolidation and rehabilitation plan. By calculating the quantity and quality potential of farmland consolidation and rehabilitation, divide potential zones. It can provide the basis for reasonable arrangement of agricultural land consolidation and rehabilitation projects, and the services for preparation of county land consolidation and rehabilitation plan.

(1)The article adopted single index method to calculate potential, which has advantage of small volume of calculated data and easy operation, but can not reflect the actual level of potential objectively. Therefore, it is better to use multi-index method to evaluate the potential comprehensively considering the quantity, quality and ecology.

(2)Use the existing results of farmland grade classification has greatly increased the efficiency of calculating the quality potential. Also it can cite farmland productivity calculation results and promote the quality potential research process.

(3)Based on implemented projects and typical survey, the calculation of the quantity potential of farmland consolidation and rehabilitation is more accurate and practical.

(4)Based on the calculation of the potential of farmland consolidation and rehabilitation, divide potential zones. It can make the consolidation and rehabilitation more targeted, and avoid appearing the situation of "renovate at a same degree".

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TABLE II. THE HIGHEST FARMLAND GRADE OF EACH TOWN IN HUAIROU

the name of town	the highest grade of the farmland	the name of town	the highest grade of the farmland
Huairou	12	Tanghekou	7
Yanqi	8	Bohai	8
Miaocheng	12	Jiuduhe	8
Beifang	15	Liulimiao	7
Yangsong	15	Baoshan	7
Qiaozi	8	Changshaoying	7
Huaibei	8	Labagoumen	7

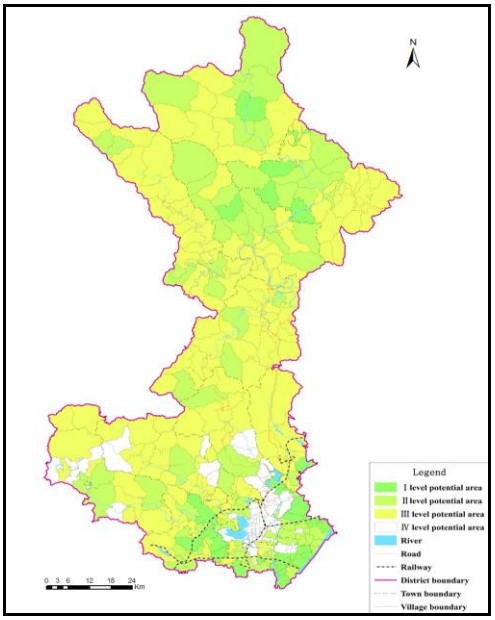

Fig. 5. Classification of the quantity potential

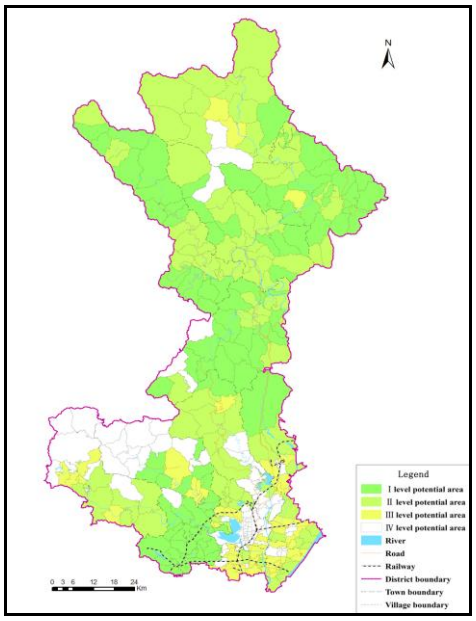

Fig. 6. Classification of the quality potential

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