Survey and Evaluation of Reserve Arable Land Resources in Xinjiang's Makit County

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Abstract Using "limiting factor" evaluation method, we make survey and evaluation of reserve arable land resources in Makit County. The results show that 9876.1 ha of land resources can be reclaimed in the county; there is no mining land to be reclaimed; 9447.58 ha of grassland can be reclaimed, and it is mainly distributed in Gazikule Township and Kizilawat Township. We make the following recommendations: broadening investment channels and increasing capital investment for arable land consolidation; combining unused land development and environmental protection; making suitability evaluation of reserve arable land resources and determining reasonable direction and path of development and reclamation.

Key words Reserve arable land resources, Survey and evaluation, Makit County

1 Introduction

To strictly protect arable land, effectively use land resources and ensure the food safety in Makit County, we actively carry out a new round of survey and evaluation on reserve arable land resources and form this evaluation report, according to the general requirements of *Notice of Office of the Ministry of Land and Resources on Carrying out National Survey and Evaluation of Reserve Arable Land Resources*, and *Notice of Department of Land and Resources of Xinjiang Uygur Autonomous Region on Carrying out Survey and Evaluation of Reserve Arable Land Resources in the Region*, as well as the standards and norms of *Survey and Evaluation Program on National Reserve Arable Land Resources*, *Technical Plan of Survey and Evaluation on National Reserve Arable Land Resources*, and *Survey and Evaluation Database Standard of Reserve Arable Land Resources*. Arable land is an important guarantee of economic and social development. In Makit County, the industrial production grows rapidly, and there is a huge demand for land, but it lacks reserve arable land resource, and it is an arduous task to protect arable land. In recent years, Makit County strictly controls the scale of construction land while ensuring the land for large projects, and increases the basic arable land protection, to ensure the stability of food production. For unlimited economic and social development under limited land resources, there is a need to economize on arable land, and increase development, consolidation and reclamation of reserve arable land resources, in order to effectively get rid of the obstacles to arable land protection and development, and achieve sustainable development of county economy and society[1-2].

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2 Object of study and data sources

2.1 Overview of the study area Makit County (77°28′-79°05′ E, 38°23′-39°22′N) is a county in the Xinjiang Uyghur Autonomous Region and is under the administration of the Kashgar Prefecture. It contains an area of 10927 km^2. It is located in the south of the Tianshan Mountains, north of the West Kunlun Mountains, and southwest edge of the Tarim Basin. It adjoins the Taklimakan Desert to the east and Yuepuhu County to the west, and borders Bachu County to the north. The oasis plain has an elevation of 1155-1195 m. It spans over 130 km from south to north, and 160 km from east to west. Makit County is 1505 km away from Urumqi and 190 km away from Kashgar. It administers one town and nine townships: Makit Town; Bazhajiemi Township; Xiyitidun Township; Yangtake Township; Tumantale Township; Gazikule Township; Kizilawat Township; Kumukusaer Township; Anggeteleke Township; Kuerma Township.

2.2 Data sources and processing The data are from the second national land survey and land use map of Makit County, topographic map, soil map, water distribution map, heat distribution map, the last round of survey and evaluation map of reserve arable land, overall land use plan (2010-2020), land development and consolidation map, the latest grading results of farmland, as well as some maps related to forestry survey, agricultural survey, nature reserve plan and environmental protection plan; the second national land survey and classification data of Makit County, land change survey and land classification data in 2012, the last round of survey and evaluation data of reserve arable land; the second national land survey database management system at county level, land change survey database in Makit County in 2012; the second national land survey report, annual land change survey report, the last round of survey and evaluation report of reserve arable land, the second soil survey report, *National Economic and Social Development Statistics Bulletin of Makit County* in 2013, unified annual output value standard and calculation report for land acquisition in

Makit County. All the above spatial data collected are transferred to the unified projection and coordinate system: projection of Gauss_Kruger, Xian_1980_3_Degree_GK_Zone_26, central meridian of 78°E; geographic coordinate system of GCS_Xian_1980, datum plane of D_Xian_1980.

2.3 Object of study In this paper, the object of study mainly includes unused land and reclaimable land. The unused land includes seven types of land: other grassland (043); tidal flat (115); mudflat (116); saline and alkaline land (124); wetland (125); sand (126); bare land (127). The reclaimable land mainly includes the land for quarrying, sand excavation and mining, as well as the abandoned land for industry and mining. It falls within the category of mining land (204). The evaluation object is reclaimable land. The evaluation unit is determined in accordance with specific conditions. If the evaluation index layers are inconsistent with the reserve arable land layers, there is a need to split map spots in order to ensure the consistency of the statistical unit, and number the split map spots to form the final evaluation unit. In accordance with the relevant national industry standards, the map spots of less than 15 mm^2 are integrated into the neighboring evaluation unit. Therefore, the evaluation unit is the smallest map spot.

2.4 Research methods

2.4.1 Technique flow. We select 11 survey and evaluation indicators of reserve arable land resources for comprehensive evaluation, and the survey and evaluation work uses the "limiting factor" evaluation method to evaluate the farming suitability of each unit of arable land (Fig. 1). Based on the survey and evaluation basemap released by the state, combined with the data about soil survey, agricultural survey, topographic map, overall land use plan, land remediation plan, ecological protection area plan and national survey of soil pollution, we obtain some evaluation indicators for reserve arable land resources such as ecological environment, site conditions, climatic conditions and location. We digitize the evaluation indicators with digital conditions, and correct them in accordance with the digital orthophoto maps in 2012 or land survey database, to create the survey database of reserve arable land resources and form the survey and evaluation results. Through the survey, we arrange the collected indicator data to form various kinds of thematic maps, and after the data are digitized, we use GIS technology for superimposition to obtain the evaluation results of related indicators of evaluation unit. Using the database software, according to the construction specifications of survey and evaluation database for reserve arable land resources, we build the survey and evaluation database for reserve arable land resources at the county level in line with database standards. After the database construction at the county level is completed, we use the quality inspection software issued by the state to check, and summarize the survey and evaluation data while writing the survey and evaluation report on reserve arable land resources at the county level. Up to now, the self-test work at the county level is completed to form the self-test report, and the technical team further improves the report based on the feedback and recommendations of Makit County. The latest comprehensive database results have been handed over to the Ministry of Land and Resources and approved by the Ministry.

2.4.2 Evaluation indicators. The evaluation indicators involve ecological environment, site conditions, weather conditions, and location, specifically including ecological conditions, annual accumulated temperature, annual precipitation and irrigation, soil pollution, drainage conditions, soil depth and parent material conditions, terrain slope, salinization degree, soil texture, soil pH, and ease of cultivation (see Table 1)[4]. As for the ecological conditions, the relevant data are generally obtained from overall land use plan, nature reserve plan, and water conservancy plan. If the evaluation basemap of reserve arable land resources issued by the state overlaps with "construction forbidden region (040)" in "construction land control zone", and "tourism land area (060)", "environmental security control area (070)" and "natural and cultural heritage protected area (080)" in "land use zone", the overlapping map spots are directly determined as not suitable for cultivation according to "limiting factor" evaluation method, and they are the areas whose reclamation is prohibited in the ecological protection zone, or there is the risk of land degradation after development. Different crops require different accumulated temperature. Makit County is in the Northwest inland, with flat alluvial plain, and annual accumulated temperature ≥1800℃ is not as a constraint on biological growth. Water is a necessary condition for crop's photosynthesis, and it is mainly from natural rainfall or irrigation. Makit County is in Northwest inland, lacking rainfall, but it has abundant water from Yarkant River and Tizinafu River for irrigation, making it possible to develop the reserve arable land resources. Meanwhile, it is rich in groundwater resources which can be used for irrigation. Soil pollution means that certain harmful chemicals in soil make the crops fail to grow or grow with toxic elements bringing hazard to health. As described in the *"Twelfth Five-Year Plan" on Environmental Protection in Makit County*, there is no soil pollution in this county. Water is a necessary condition for crop growth, but too much water will cause water logging, so good drainage conditions can ensure the normal growth of crops. Due to seasonal high water table, it is difficult to reclaim tidal flat into reserve arable land; there is only need to enclose mudflat for cultivation or fill in the low area of mudflat, with small workload. Reasonable drainage is a prerequisite for normal growth of crops. Certain thickness of soil is the environment for plant life, and the rock type determines the weathering difficulty. Limestone, marble, quartzite and other carbonate rocks are difficult to weather. Makit County is a large area in Northwest China, and except other grassland, bare land and mining land, other unused land is not as evaluation indicator. Local terrain slope is an important factor affecting soil erosion, and by taking into account the mechanized operation, the terrain with slope >25° should not be reclaimed. The ceiling slope of the other grassland suitable for farming is 15°, while the ceiling slope of sand, bare land and

mining land is 6°. Soil salinization is the accumulation of soluble salts of sodium, magnesium and calcium in soil to the extent that soil fertility is severely reduced. It can affect the normal growth of crops. For the soil with low content of soluble salts, it can be reclaimed into arable land using natural rainfall or irrigation water. If it evolves into saline and alkaline land, this indicator will not be as the evaluation indicator. Soil texture is known as a qualitative classification instruments used both the field and laboratory for agricultural soils to determine classes for based on their physical texture. It provides an important basis for soil reclamation, utilization and management. It is usually divided into sand soil, loam and clay. The sand soil has some ability to absorb water, but reclamation and utilization require a lot of water. Soil pH level greatly affects the soil nutrient effectiveness, so we can plant the crops at the corresponding pH level. When pH > 9.5, it is alkaline soil and the soil colloids may be scattered, with poor permeability. When pH < 4, the soil is highly acidic, and it is difficult to grow crops; we can grow mangrove to become ecological landscape mangrove. It can not be determined as reserve arable land resource. Land development needs to consider ease of cultivation, and if land area is less than 20 ha, it is necessary to consider the road accessibility. Under the perspective of maximizing reclamation efficiency, the land in too far places should not be reclaimed, and it does not fall within the category of reserve arable land. If the land area is greater than 20 ha, we do not need to consider the road accessibility. When other indicators meet the conditions, it can be deemed reserve arable land.

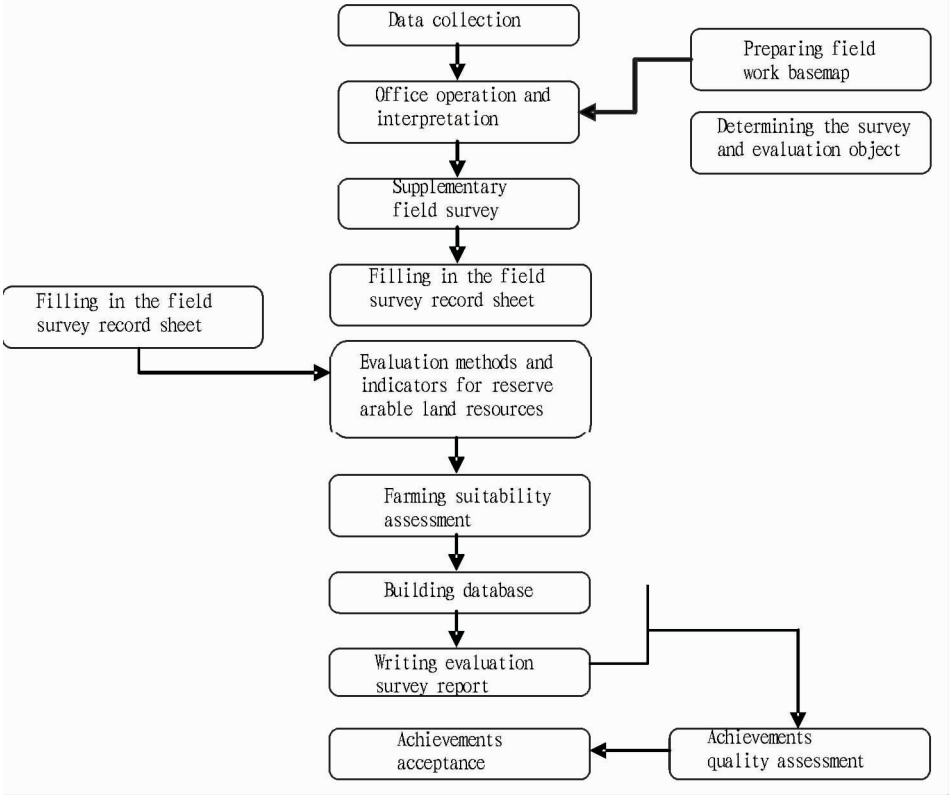

Fig. 1 Survey technology roadmap of reserve arable land resources in Makit County

3 Potential of the reserve arable land resources

In the survey and evaluation zoning of national reserve arable land, Makit County is in Northwest. After field survey and analysis, it is found that 9876.1 ha of land in the county can be reclaimed, and the mining land can not be reclaimed and is not evaluated; 9447.58 ha of other grassland can be reclaimed; 100.14 ha of saline and alkaline land can be reclaimed; 328.04 ha of sand can be reclaimed; 0.34 ha of bare land can be reclaimed. Other reclaimable grassland accounts for 18.39% of total other grassland, mainly distributed in Tumantale Township, Gazikule Township, Kumukusaer Township, Kuerma Township, and Bazhajiemi Township; the reclaimable saline and alkaline land accounts for 0.01% of total saline and alkaline land, mainly distributed in Xiyitidun Township, Anggeteleke Township, and Kuerma Township; the reclaimable sand accounts for 0.04% of total sand, mainly distributed in Gazikule Township and Kizilawat Township; the reclaimable bare land accounts for 0.11% of total bare land, mainly distributed in Anggeteleke Township; there is no tidal-flat area (Table 2).

Table 1 Evaluation indicators for various kinds of reserve arable land resources in Makit County

Types of land	Ecological conditions (X_1)	Annual accumulated temperature of more than 10℃ (X_2)	Annual rainfall and irrigation conditions (X_3)	Soil pollution (X_4)	Drainage conditions (X_5)	Soil parent material thickness and conditions (X_6)	Terrain slop (X_7)	Salinization degree (X_8)	Soil texture (X_9)	Soil pH (X_{10})	Ease of cultivation (X_{11})
Other grassland	The area whose reclamation is prohibited in the ecological protection zone, or there is the risk of land degradation after development	<1800℃	Without irrigation	Soil contamination		Thickness < 60cm	≥15°	High degree of soil salinization, without irrigation and drainage conditions	Gravelly soil or coarser gravel or the rock outcropping degree of greater than 2%	pH≥9.5	Map spot area of less than 20 ha, without roads
Mudflat	The area whose reclamation is prohibited in the ecological protection zone, or there is the risk of land degradation after development	<1800℃		Soil contamination	Without drainage conditions			High degree of soil salinization, without irrigation and drainage conditions	Gravelly soil or coarser gravel		Map spot area of less than 20 ha, without roads
Saline and alkaline land	The area whose reclamation is prohibited in the ecological protection zone	<1800℃	Without irrigation	Soil contamination	Without drainage conditions					pH≥9.5	Map spot area of less than 20 ha, without roads
Wetland	The area whose reclamation is prohibited in the ecological protection zone, or there is the risk of flooding after development	<1800℃		Soil contamination	Without drainage conditions						Map spot area of less than 20 ha, without roads
Sand	The area whose reclamation is prohibited in the ecological protection zone, or there is the risk of land degradation after development	<1800℃	Without irrigation	Soil contamination	Without drainage conditions		≥6°	High degree of soil salinization			Map spot area of less than 20 ha, without roads
Bare land	The area whose reclamation is prohibited in the ecological protection zone, or there is the risk of land degradation after development	<1800℃	Without irrigation	Soil contamination	Without drainage conditions	Thickness < 60cm	≥6°	High degree of soil salinization	Gravelly soil or coarser gravel or rock	pH≥9.5	Map spot area of less than 20 ha, without roads
Land for mining	The area whose reclamation is prohibited in the ecological protection zone, or there is the risk of land degradation after development	<1800℃	Without irrigation	Soil contamination	Without drainage conditions	Occupied soil thickness < 60cm, without new soil source, or pit is too large to fill	≥6°	High degree of soil salinization	Sand soil or gravelly soil or coarser gravel	pH≥9.5	Map spot area of less than 20 ha, without roads

Table 2 Distribution of reclaimable reserve arable land resources in various areas of Makit County Unit: ha

Administrative areas	Total	Reclaimable other grassland	Reclaimable saline and lkaline land	Reclaimable sand	Reclaimable bare land
Makit County	9876.10	9447.58	100.14	328.04	0.34
Qiasi Farm					
Xiyitidun Township	424.30	414.96	9.34		
Tumantale Township	899.38	889.61		9.77	
Gazikule Township	2968.07	2780.06		188.01	
Kizilawat Township	2306.30	2182.06		124.24	
Kumukusaer Township	923.29	923.29			
Anggeteleke Township	325.61	312.05	7.20	6.02	0.34
Kuerma Township	1102.78	1019.18	83.60		
Bazhajiemi Township	926.37	926.37			

4 Recommendations

4.1 Broadening the investment channels and increasing capital investment for land consolidation Firstly, it is necessary to obtain funds from various channels, and increase investment in arable land consolidation. Secondly, it is necessary to establish

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channels and ditches along roads and carry out green belt and buffer zone construction.

4.4 Farmland protection and ecological environment protection works Farmland protection forest construction should attach great importance to restoration of natural vegetation, increase green corridors and separate plots, bushes, simulate regional natural plant communities, take full advantage of local plants, and establish ecological economical landscape protection forest system [13]. (i) Natural materials should be used in construction, to manifest local unique landscape, combine with rural scene, and create natural beauty of environment. (ii) Low-lying areas may be established as ecological protection zone. Low-lying area is commonly called swamp or marsh. Although with barren productivity, low-lying area is excellent habitat for wild plants and animals. Thus, it can be designed as ecological protection zone, planting forage grass or aquatic plants, realizing sustainable ecological environment. (iii) It is recommended to survey and cultivate indigenous species. Since it is easier to restore indigenous species, it is required to carry out detailed survey, screening and cultivation, to benefit ecological protection of the project area [4].

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the linkage mechanism of land consolidation and land development, to promote local government to attach importance to arable land remediation. Thirdly, it is necessary to give priority to the consolidation of the arable land areas with good location and transportation conditions, gentle slope, farm roads, and complete water conservancy facilities; establish land consolidation project, make public bidding, and attract social capital investment in arable land consolidation to expand the scale of consolidation [3].

4.2 Paying attention to both unused land development and environmental protection The soil is barren and the desertification is serious in Makit County, and for the development and utilization of unused land, there is a need to strengthen environmental protection and prevent soil erosion, ecological degradation and desertification, and build ecological forests to strengthen environmental protection. At the same time, it is necessary to regulate the occupation of arable land for production and construction projects, select the dump site in the unused land area in advance for the construction projects in the overall plan, effectively protect and use the topsoil and improve the soil of unused land to ensure the quality of new arable land.

4.3 Making evaluation on the suitability of reserve arable land resources The suitability evaluation is mainly for reclaimable reserve resources, and according to the natural conditions, damage and difficulty in exploitation, it is necessary to determine the appropriate level, take full account of land suitability in evaluation. In addition to considering the suitability conditions and economic factors, there is also need to use the agricultural geographical location theory to determine the rational development and utilization direction of reserve arable land resources according to the location and traffic conditions [5].

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