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Research on Overall Planning and Implementation Evaluation of Land Use of Xinjiang Production and Construction Corps Agriculture-seven Division

Ru BAO, Minhua GAO, Xiaolong LI

The Oasis Ecological Key Laboratory, School of Resource and Environmental Science, Xinjiang University, Urumqi 830046, China

Abstract Based on methods for evaluating the overall planning and implementation of land use of domestic scholars, a comprehensive and highly-operable index system and evaluating method for land use planning multi-type implementation has been established through selecting multi-type evaluating indicators and applied to the last-round overall planning of land use in Xinjiang Production and Construction Corps Agriculture-seven Division. The obtained comprehensive score was 86.40, indicating that land use overall planning has been excellently coordinated with land, society, economy as well as ecology and has exerted outstanding effect with the rank as "good". The evaluation results are in accordance with actual conditions, which displays that the established multi-type implementation evaluating system of land use overall planning is reasonable with scientific evaluating methods and can be the reference for evaluation of land use overall planning in other regiments and companies of Xinjiang Production and Construction Corps.

Key words Xinjiang Production and Construction Corps, Agriculture-seven Division, Overall Planning of Land Use, Implementation Evaluation, Multi-type, Evaluating Indicator system

Overall planning of land use is to achieve the state's micro-control on land through optimizing land resource allocation and provide basis for reasonable as well as effective utilization of land resource^[1]. Evaluation of overall land use planning is an important component of overall land use compilation and one of the new subjects in the present land management science^[2]. Recent years, some scholars have analyzed and concluded the definition as well as related theories of evaluation of overall land use planning. The researches made qualitative analysis on influencing factors with pure mathematical statistics and combined the quantitative analysis with qualitative analysis to establish the index system and mathematical mode of land overall planning implementation evaluation^[3–6].

However, there are still problems in researches on land use overall planning, such as single and superficial methods as well as backward technology^[7], even fewer researches on establishing multi-type evaluating system of overall land planning with the combination of qualitative and quantitative analysis. The writer established a comprehensive and highly-operable index system and evaluating method for land use planning multi-type implementation based on methods for evaluating the overall planning and implementation of land use of domestic scholars and through selecting multi-type evaluating indicators and applied the evaluating system to the last-round overall planning of land use in Xinjiang Production and Construction Corps Agriculture-seven Division. Reasons are analyzed and related measures as well as suggestions are proposed according to the evaluation results, providing reference for

the new land overall planning of the Agriculture-seven Division.

1 Establishment of multi-type evaluation mode of overall land use planning

1.1 Establishment of multi-type evaluating indicator system

The main content of the implementation evaluation of overall land use planning is to compare and analyze the difference between the planning guidelines launched by the super ordinates and the actual achievement at the end of planning and make overall evaluation combing the economic, social and ecological profits before and after the planning^[8]. Therefore, implementation evaluation of overall land use planning should be scientific, dominant, hierarchical, comprehensive as well as operable^[9]. Based on the above principles, 4 aspects of land, society, economy and ecology and 14 evaluating indicators are selected to establish multi-type evaluation indicator system (Tab. 1) for the specific overall land planning evaluation.

1.2 Weight determination of evaluating indicators Importance of indicators is analyzed by experts in various fields and the relative importance is compared with the scaling method (–8, 8) (Tab. 2) to get a judgement matrix A (Tab. 3). Then, importance index of each indicator is calculated $i = \sum a_{ij}$, $i = 1, 2, \dots, n$, and the elements of new judgement matrix B are obtained

$$b_{ij} = \begin{cases} r_i - r_j + 1 & r_i \geq r_j \\ 1/(r_j - r_i + 1) & r_i < r_j \end{cases}$$

thus a new judgement matrix B (Tab 4).

In terms of judgement matrix B, the maximum eigenvalue λ_{\max} is first calculated and then the relevant standard eigenvector w is calculated, namely $A w = \lambda_{\max} \times w$ among which components (w_1, w_2, \dots, n) of are the weights of corresponding n indicators.

With the weight determination method and experts in related fields, importance of each indicator is comprehensively evaluated to get the maximum eigenvalue $\lambda_{\max}=4.1606$ and weights of each

main indicator (Tab. 5). It can be seen from Tab. 5 that weights in land type, society type, ecology type and economy type are 0.519 0, 0.054 4, 0.074 9 and 0.350 6 respectively.

Table 1 Multi-type indicator system of land overall planning evaluation

Type	Evaluating indicator	evaluating indicator quantization	weight
Land E_1	Basic farmland protection (low limit control index) F_1	Actual area of basic farmland/planned area of basic farmland	w_1
	Cultivated land protection (low limit control index) F_2	Actual area of cultivated land/planned area of cultivated land	w_2
	Urban and rural construction land control (upper limit control index) F_3	Actual area of urban and rural construction land/planned area of urban and rural construction land	w_3
	Overall construction land control (upper limit control index) F_4	Actual total area of construction land/planned total area of construction land	w_4
	Newly-increased construction land control (upper limit control index) F_5	Actual area of newly-increased construction land/planned area of newly-increased construction land	w_5
	Supplementary cultivated land task in land reclamation (low limit control index) F_6	Actual supplementary cultivated land task in land reclamation/planned supplementary cultivated land task in land reclamation	w_6
Society E_2	Population urbanization F_7	Non-agricultural population/total population	w_7
	Governmental recognition on planning F_8	Questionnaire	w_8
	Public recognition on planning F_9	Questionnaire	w_9
Economy E_3	Growth rate of GDP F_{10}	Difference between present-year GDP and last-year GDP/last-year GDP	w_{10}
	Growth rate of per capita net income F_{11}	Difference between present-year per capita net income and that in last year/last-year per capita net income	w_{11}
	Growth rate of fixed assets investment F_{12}	Difference between present-year fixed assets investment and that in last year/last-year fixed assets investment	w_{12}
Ecology E_4	Forest land retention F_{13}	Actual area of forest land/planned area of forest land	w_{13}
	Grassland retention F_{14}	Actual area of grassland/planned area of grassland	w_{14}

Table 2 Scaling method

Scaling	Significance
8	A is extremely important than B /advantageous
6	A is quite more important than B /advantageous
4	A is relatively more important than B /advantageous
2	A is slightly more important than B /advantageous
0	A is as important as B
-2	B is extremely important than A /advantageous
-4	B is quite more important than A /advantageous
-6	B is relatively more important than A /advantageous
-8	B is slightly more important than A /advantageous

Table 3 Judgement matrix A

A	A_1	...	A_n
A_1	a_{11}	...	a_{1n}
A_2	a_{21}	...	a_{2n}
...
A_n	a_{n1}	...	a_{nn}

Table 4 Judgement matrix B

B	B_1	...	B_n
B_1	b_{11}	...	b_{1n}
B_2	b_{21}	...	b_{2n}
...
B_n	b_{n1}	...	b_{nn}

Table 5 Weights of main indicators

Type	Land	Society	Ecology	Economy	w_i
Land	1.00	8.00	6.00	2.00	0.519 0
Society	0.13	1.00	0.50	0.20	0.055 4
Ecology	0.17	2.00	1.00	0.13	0.074 9
Economy	0.50	5.00	8.00	1.00	0.350 6

With this method, weight of each single index of main indicators is determined with analogy.

Weight of each single index in land type can be seen in Tab. 6. Weight of basic farmland protection F_1 in land type is 0.158 7. Weight of cultivated land protection F_2 is 0.117 8. Weight of urban and rural construction land control F_3 is 0.257 0. Weight of total construction land control F_4 is 0.166 5. Weight of newly-increased construction land control F_5 is 0.200 0. Weight of supplementary cultivated land task control in land reclamation F_6 is 0.100 0.

Table 6 Weight of each single index in land type

Land type	F_1	F_2	F_3	F_4	F_5	F_6	w_i
F_1	1.00	2.00	0.50	1.00	0.50	2.00	0.158 7
F_2	0.50	1.00	0.33	0.50	1.00	2.00	0.117 8
F_3	2.00	3.00	1.00	3.00	0.50	2.00	0.257 0
F_4	1.00	2.00	0.33	1.00	1.00	2.00	0.166 5
F_5	2.00	1.00	2.00	1.00	1.00	1.00	0.200 0
F_6	0.50	0.50	0.50	0.50	1.00	1.00	0.100 0

Weight of each single index in society type can be seen in Tab. 7. Weight of population urbanization F_7 is 0.60. Weight of governmental recognition on planning F_8 is 0.20. Weight of public recognition on planning F_9 is 0.20.

Table 7 Weight of each single index in society type

Society type	F_7	F_8	F_9	w_i
F_7	1.00	3.00	3.00	0.600 0
F_8	0.33	1.00	1.00	0.200 0
F_9	0.33	1.00	1.00	0.200 0

Weight of each single index in economy type can be seen in Tab. 8. Weight of GDP growth rate F_{10} is 0.39. Weight of per capita net income growth rate F_{11} is 0.44. Weight of fixed assets investment growth rate F_{12} is 0.17.

Table 8 Weight of each single index in economy type

Economy type	F_{10}	F_{11}	F_{12}	w_i
F_{10}	1.00	1.00	2.00	0.390 0
F_{11}	1.00	1.00	3.00	0.440 0
F_{12}	0.50	0.33	1.00	0.170 0

Weight of each single index in ecology type can be seen in Tab. 9. Weight of forest land retention F_{13} is 0.75. Weight of grassland retention F_{14} is 0.25.

Table 9 Weight of each single index in ecology type

Ecology type	F_{13}	F_{14}	w_i
F_{13}	1.00	3.00	0.750 0
F_{14}	0.33	1.00	0.250 0

Based on the weight of each main indicator, weight of each single index can be obtained through weighting.

1.3 Standardization of evaluating indicators Indicators of implementation evaluation are classified into three categories, namely upper limit control index, low limit control index and effect index. With the adoption of standard value processing, evaluating indicators of different types are standardized according to the following two formulas.

Table 10 Weight of each single index

w_1	w_2	w_3	w_4	w_5	w_6	w_7	w_8	w_9	w_{10}	w_{11}	w_{12}	w_{13}	w_{14}
0.0824	0.0611	0.1334	0.0864	0.1038	0.0519	0.0333	0.0111	0.0111	0.1358	0.1555	0.0593	0.0562	0.0187

Table 11 Standard of overall land planning implementation evaluation

Comprehensive evaluation score	Evaluating rank	Evaluation statement
$80 \leq C \leq 100$	Excellent	During the implementation, overall land planning is excellently coordinated with land, society, economy as well as ecology and has exerted outstanding effect.
$60 \leq C < 80$	Good	During the implementation, overall land planning is well coordinated with land, society, economy as well as ecology and has exerted certain effect.
$40 \leq C < 60$	Qualified	During the implementation, overall land planning is generally coordinated with land, society, economy as well as ecology with no obvious effect.
$20 \leq C < 40$	Relatively bad	Implementation of overall land planning is relatively bad with most goals having not been achieved, no coordination with land, society, economy as well as ecology and no effect.
$0 < 20$	Bad	Implementation of overall land planning is extremely bad with all planned goals having not been achieved, no coordination with land, society, economy as well as ecology and extremely bad effect.

2 Implementation evaluation on the last-round overall land planning of Agriculture-seven Division based on the multi-type evaluation index system

2.1 Overview of research region Xinjiang Production and Construction Corps Agriculture-seven Division is situated in the central north of Xinjiang Uygur Autonomous Region, to the north of Tianshan Mountains and on the southwestern edge of the Junggar

$$F_i = \begin{cases} \frac{x_i}{z_i} \times 100 & (0 \leq x_i \leq z_i) \\ 100 & (x_i > z_i) \\ 0 & (x_i < 0) \end{cases} \quad (1)$$

$$F_i = \begin{cases} 100 & (0 \leq x_i < z_i) \\ \left[\frac{1 - (x_i - z_i)}{z_i} \times 100 \right] & (z_i \leq x_i \leq 2z_i) \\ 0 & (x_i > 2z_i) \end{cases} \quad (2)$$

In the formulas, F_i is indicator quantization value. x_i is the actual number at the end of planning obtained from local statistics. z_i is the planning index value launched by the superior ordinates. Low limit control index and effect index are quantitatively processed with formula (1) while upper limit control index and effect index are quantitatively processed with formula (2). Recognition index values like F_8 and F_9 are obtained from questionnaire with no need for quantization.

1.4 Evaluating mode The Evaluating mode of overall implementation is

$$C = \sum_{i=1}^n F_i \times w_i \quad (n = 1, 2, \dots, 14) \quad (3)$$

In the formular, C is the comprehensive evaluation score of overall land planning implementation. F_i is the score of evaluating indicator. w_i is the weight of evaluating indicator.

According to the calculated comprehensive evaluation score C , the corresponding qualitative judgement standard (Tab. 11) is formulated.

Basin. The reclamation area lies on the northern piedmont plain of Tianshan Mountains, adjacent to Tianshan Mountains in the south, Karamay city in the north, Anjihai River of Shawan County in the east and Wusu city in the west. Agriculture-seven Division belongs to the continental north temperate climate and is one of the regions with the most adequate light and heat as well as the longest frost-free period in northern Xinjiang. Summer is hot while winter

is freezing with low rainfall, high evaporation, dry air and big daily temperature difference. Agriculture-seven Division is in charge of 10 ranches and other units with the 124 regiment, 125 regiment, 130 regiment and 131 regiment in the south while 123 regiment, 126 regiment, 127 regiment, 128 regiment and 129 regiment in the north. The 137 regiment is located to the north of Karamay city. The first water conservancy department and the second water conservancy department, as water management institutes, are distributed in the mountainous area and within each ranch. The division is in Kuitun city with the total land area of 458 800 hm². By the end of 2009, Agriculture-seven Division has a population of 216 030 people with agricultural population of 113 284 people and non-agricultural population of 102 746 people.

Table 12 Results of implementation evaluation of overall land use planning in Agriculture-seven Division

Administrative region	total	Land type	Society type	Economy type	Ecology type
Agriculture-seven Division	86.40	48.95	4.37	26.72	6.36
123 regiment	76.10	40.58	4.40	27.03	4.10
124 regiment	76.27	41.51	4.30	26.00	4.46
125 regiment	75.49	40.19	4.11	26.36	4.83
126 regiment	78.60	45.67	4.23	23.84	4.86
127 regiment	69.84	40.93	4.26	17.39	7.25
128 regiment	71.05	43.13	4.07	19.82	4.02
129 regiment	70.11	42.45	4.89	18.06	4.71
130 regiment	67.40	41.15	4.65	18.55	3.05
131 regiment	60.85	38.56	4.32	15.52	2.44
137 regiment	60.06	39.20	4.32	14.87	1.67
First water conservancy department	74.62	43.73	4.62	21.07	5.20
Second water conservancy department	47.37	29.06	4.41	10.00	3.90

Note: ① statistics in the table are calculated according to the land updated date of Agriculture-seven Division, social and economic statistical materials as well as annuals and basic data in the overall land use planning revision of Agriculture-seven Division (1997–2010). ② Industry-eight Regiment was allocated to Agriculture-seven Division in February, 2004 and was renamed as Agriculture-seven Division Industry – eight Regiment, therefore implementation of overall land use planning of Industry – eight Regiment was not evaluated. ③ Since northern Tianshan Mountain new region was allocated out of the 131 regiment to be independent, so data concerning the northern Tianshan Mountain new region should be calculated in the 131 regiment in order to maintain the data consistency before and after the planning. ④ Scores of divisions in Agriculture-seven Division were higher than those in all other units, that is because the scores were standardized and weighted according to the overall data, not the average score of those in all regiments.

(1) seen from the overall score: ① The comprehensive score of implementation evaluation of overall land use planning in Agriculture-seven Division is 86.40. It can be judged from the evaluation standard that during the whole implementation of overall land use planning of Agriculture-seven Division, the overall planning has been excellently coordinated with land, society, economy as well as ecology and has exerted outstanding effect. The evaluation is ranked as "excellent". ② As for each regiment and unit, implementation of overall land use planning is basically "good" with only the implementation in the second water conservancy department ranked as "qualified". ③ It can be concluded from the above evaluation result that overall land use planning has played a significant role in territorial resources management of Agriculture-seven Division, effectively controlled total construction land, urban and rural construction land as well as newly-increased construction land and strictly preserved cultivated land as well as basic farmland. The whole division generally has achieved good land, social, economic and ecological profits.

(2) seen from the land type: The whole division has strictly

Agriculture-seven Division has achieved gross production value of 502 041 million yuan with the first industry, the secondary industry and the tertiary industry reaching 210 683 million yuan, 154 898 million yuan and 1364,59 million yuan respectively. And per capita gross production value was 23081 yuan.

2.2 Implementation evaluation and analysis of overall land planning in Agriculture-seven Division

According to the multi-type evaluating index system and evaluation method of overall land planning discussed above, weights of indicators are first calculated. Then, indicators are standardized with formular (1) and formular (2) and the comprehensive scores are finally calculated with formular (3). Results can be seen in Tab. 12.

carried out the land use management rules and effectively protected cultivated land as well as basic farmland. Over the last-round planning, Agriculture-seven Division has strictly followed the requirement in Land Management Law of People's Republic of China, deeply carried out cultivated land preservation work with basic farmland as the core and firmly enforced the standards of basic farmland preservation. According to the last-round planning, the area of basic farmland in the whole division would have been 79 826 hm² by 2009 while the actual area of basic farmland was 92 592.20 hm² in 2009, overfulfilling basic farmland preservation index. And implementation of the 126 regiment has the most obvious effect with a score of 45.67.

(3) seen from the society type: under the steady implementation of overall land planning, population urbanization of Agriculture-seven Division has increased with a relatively high speed and living conditions of workers in the regiment have been obviously improved. Meanwhile, recognition on overall land planning of the regiment and the public has been gradually increased and awareness of reasonably and legally using land according to the overall

Spatial distribution of overall land use planning evaluation of Agriculture-seven Division

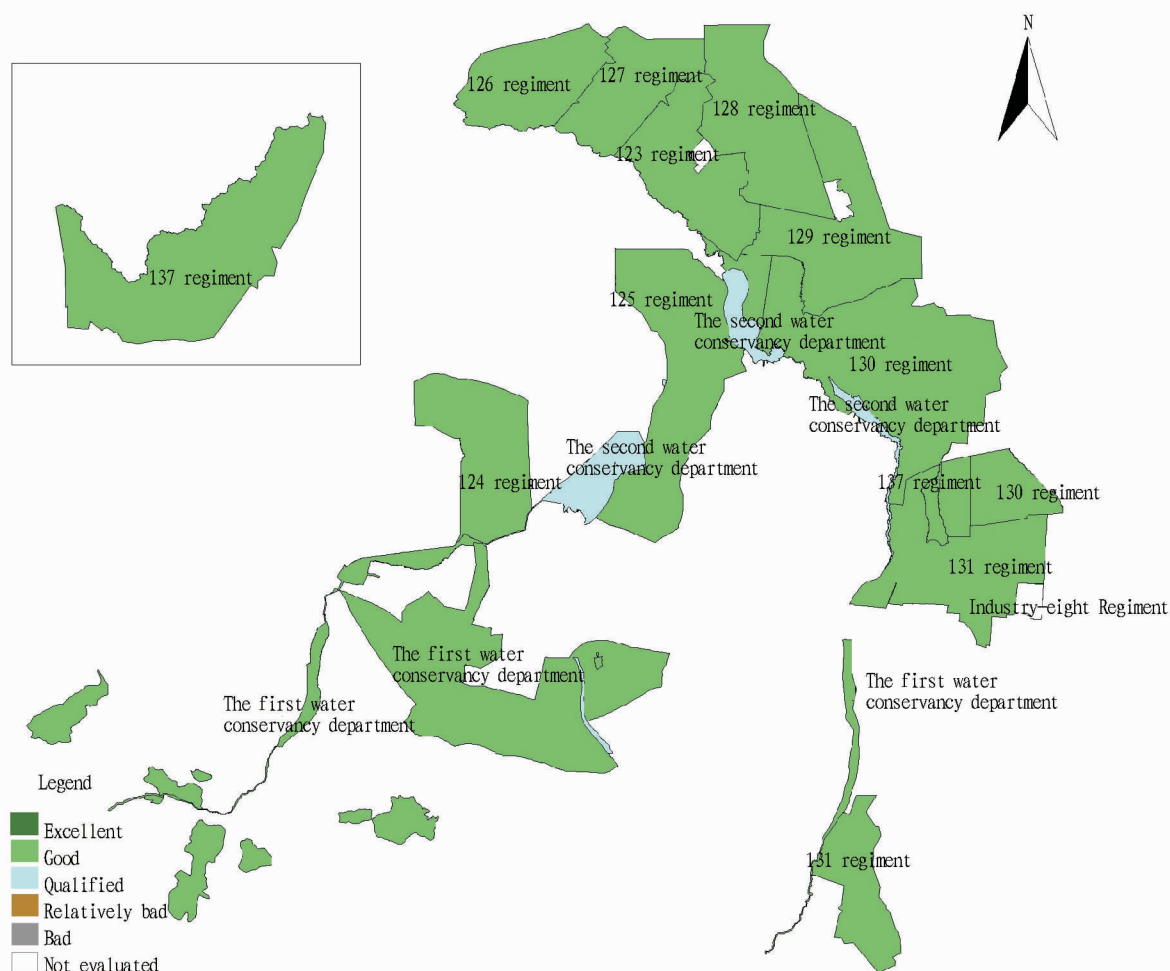


Fig.1 Spatial distribution of overall land planning evaluation of Agriculture-seven Division

land planning has been deepened. Population urbanization has increased from 28.3% in 1996 to 47.56% in 2009. Since the 129 regiment is close to the division and Kuitun city, the regiment has dramatically increased the population urbanization with its own advantages as well as the external advantages during the planning with a score of 4.89, ranking the first among all the regiments and units.

(4) seen from the economy type: last-round overall land planning in Agriculture-seven Division has basically guaranteed land for each key construction project and largely promoted the development of national economy. GDP of the whole division has increased from 1.085 billion yuan in 1996 to 5.020 billion yuan in 2009 with the average yearly increasing rate of 280 million yuan. Per capita net income has increased from 4 246 yuan in 1996 to 18 560 yuan in 2009 with the average yearly increasing rate of 1 101.18 yuan. During the planning, the 123 regiment has largely increased its economy by making full use of its own advantages as well as external advantages like convenient transportation and relatively strong economy and achieved the highest score.

(5) seen from the ecology type: during the planning, the

whole division emphasized ecological protection and ecological construction, not only strengthened forest land preservation and strictly carried out tree cutting rules but largely promoted the work of forest planting and strengthened the protection of grassland. The 127 regiment has made the most outstanding achievement in forest land retention and grassland retention with the highest score.

(6) The following conclusions can be made through analyzing and evaluating the implementation of overall land planning of Agriculture-seven Division. The overall evaluating scores and evaluating ranks are basically the same in spatial distribution (Pic. 1), which explains that there is close interrelationship among regiments to achieve reciprocity and harmonious development. Regiments with relatively developed social economy do not necessarily achieved well in overall land planning, such as the 131 regiment. Some control index cannot be achieved or overfulfilled in order to largely develop social economy. These regiments and units should be suggested to make proper prediction on construction land when compiling the planning and allocated basic farmland as much as possible. Meantime, these regiments should actively communicate with the division, trying to win more construction land index.

Regiments with relatively good implementation of overall land use planning do not necessarily have developed social economy, such as the 137 regiment, which has relatively good implementation and high score but the actual social economic profits have not been increased accordingly. This is because the 137 regiment is far away from Kuitun city with remote geographical location. Besides, economic growth largely depends on the first industry with low economic level and weak foundation while the secondary as well as tertiary industry is small with unbalanced development. These units should be suggested to fully exerted the guiding role of the planning, making sure that overall land planning exerts more favorable effect on promoting social and economic development. There are certain contradictions among the land, society, economy and ecology and overall land use planning can be better implemented only with good coordination among the four types.

3 Conclusion

Based on methods for evaluating the overall planning and implementation of land use of domestic scholars, a comprehensive and highly-operable index system and evaluating method for land use planning multi-type implementation has been established through selecting multi-type evaluating indicators and applied to the last-round overall planning of land use in Xinjiang Production and Construction Corps Agriculture-seven Division, which concludes that overall land use planning has been excellently coordinated with land, society, economy and ecology and has exerted outstanding effect with the evaluating rank "excellent". All the regiments are ranked as "good" except for the second water conservancy department which is ranked as "qualified". Overall land planning has played significant role in the territorial resources management of Agriculture-seven Division, effectively controlled the construction land, urban and rural construction land and newly-increased construction land, strictly protected cultivated land and basic farmland and generally achieved good land, social, economic and ecological profits. The overall evaluating scores and evaluating ranks are basically the same in spatial distribution, which indicates that association between connected regiments is

close. These are in accordance with the actual condition, which explains that the established multi-type overall land planning evaluation system is reasonable and scientific and can provide reference for evaluation of land use overall planning in other regiments and companies of Xinjiang Production and Construction Corps.

However, implementation of overall land use planning is dynamic and changes with social economic development. Besides, selection of indicators and experts' judgement on weight matrix are inevitably subjective, which is the weak point of the evaluation system. The evaluation system can be adjusted and revised based on the actual conditions in the research area and more scientific methods should be adopted in order to better serve the next-round compilation of overall land use planning.

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