Evaluation of water resources carrying capacity of major industries in northwest of China: A case study of textile industry in Aksu, Xinjiang Province, China

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Abstract. With the implementation of the “Belt and Road Initiative”, the north-western region of China is welcoming a new development opportunity. Textile industry is a vital industry for people’s livelihood in Xinjiang, which plays an important role in promoting the development of related industries, stimulating the growth of domestic demand, increasing the capacity and level of employment, and promoting social harmony. However, the spatial and temporal distribution of water resources in Xinjiang is extremely uneven, the contradiction between water resources shortage with economic and social development is increasingly prominent. This paper aims to figure out the pressure degree on water resources with the development of textile industry, propose the countermeasures of water saving and pollution reduction in textile industry, by using the osculating value method model to evaluate the water resources carrying capacity (WRCC) of Aksu’s textile industry. Results indicates that the water resources carrying capacity in the study area was overload in 2015, the water consumption of textile industry and the agricultural irrigation were the dominant factors caused a situation of an overloaded water resources carrying capacity. Beside government issues policies to limit water resources consumption and sewage permit system, the optimal measure for reversing this situation is to adopt advanced technologies in water conservation and pollution control in textile industry and new water-saving technology of agriculture irrigation.

Keywords: “Belt and Road Initiative”; Textile Industry; Water Resources Carrying Capacity; Osculating Value Method Model

1. Introduction
Water is a critical resource for the survival and development of human society. Because of the uneven spatial and temporal distribution of water resources, coupled with the unreasonable development and the utilization of water resources, water shortage and the deterioration of water resources have become global problems, seriously restricting the economic development of various countries [1]. Most of the problems are mainly caused by the aggravation of population pressure, over-exploitation of water resource and environmental degradation [2]. With the highly economic development of China, especially since the large-scale economic construction in the late 1970s, the rapid social development leads to increasing water consumption, increasing sewage discharge and strongly artificial disturbance to the ecosystem [3]. The northwestern region is located at the hinterland of China, where is characterized as low precipitation, low available water resources and fragile ecological environment, particularly in the arid and semi-arid areas [4]. The problem of water resource shortage and ecological
environment destruction caused by the irrational utilization of water resources have become the restricting factor of sustainable development in this area. Therefore, the study of WRCC has important theoretical and practical significance for the scientific and rational utilization of water resources, economic development, environmental protection and ecological balance in arid and semi-arid areas of northwest China.

In 2015, China proposed the “Belt and Road initiative”. Based on its distinctive regional advantages and its role in opening channel to west to Asia, Europe and Africa, Xinjiang was clearly positioned as the “core area of the silk road economic belt”. The textile industry is a traditional pillar industry and an important livelihood industry in Xinjiang, which is characterized by high labor intensity and high dependence on foreign trade. Moreover, with the advantages of cotton resources, textile industry has been upgraded to a strategic level in Xinjiang. For instance, Xinjiang’s cotton planting area reached about 1.9 million square hectometer and its total cotton output approximately achieved 3.5 million tons, accounting for 50.1% and 62.5% of the country's cotton planting area and output, respectively [5]. Xinjiang has abundant water resources; major water resources are used to support agriculture and the industrial water is relatively scarce.

Many scholars have done research on water resources carrying capacity due to economic activities in China. Song [6] analyzed Xinjiang’s water resources carrying capacity in coal-chemical industry by the method of balance index, the results showed a large-scale coal-chemical industry in Xinjiang was not encouraged, under the limited water resource and technological level, the number of coal-chemical projects should be cut down. Based on water quantity, water quality factors and social and economic development indicators, Huo et al. evaluated the current the water resources carrying capacity and causes of current overload of the Yangtze River Economic Belt and analyzed its water resources carrying potential [7], the results showed that 86% of the county units in the Yangtze River Economic Belt were not overloaded by water resources, 10% of the county units in the critical stage of water resources, the proportion of county units with water resource overload and serious water resource overload were about 2%, the reasons of overloaded water resources were the spatial mismatch between the social and economic development of the Yangtze Economic Belt with WRCC, the ineffective prevention and control of water pollution and the imperfect comprehensive water pollution management system. In order to establish the index system for evaluation of the stage of economic development of Dalian (China), Chai (2011) has applied the indexes of income, industry development, urbanization [8], technology development, consumption and environment development to comprehensively measure the stage of city economic development of Dalian, variable fuzzy recognition model was used to analyze the water resources carrying capacity and stage of economic development assessment of Dalian from 1996 to 2009, the result indicated that the state of water resources carrying capacity and economic development in Dalian improved synchronously on the whole, the trend of water resources development lag behind the social and economic development began to appear in later years.

2. The origin and research process of WRCC
Carrying capacity is originally a physical concept, which refers to the maximum load that an object can withstand without causing any damage [9-11]. Park et al. (1921) firstly applied this concept into the field of human ecology and pointed out the population carried by an area can be determined based on food resources [9,11,12,13]. The concept of resources carrying capacity was proposed by United Nations Educational, Scientific and Cultural Organization (UNESCO) in the early 1980s [14]. After decades of development, resource carrying capacity has involved many resource systems, such as ecological carrying capacity, environmental carrying capacity, water resources carrying capacity and land carrying capacity. In China, the research on the WRCC can be divided into four stages [15]: 1985-1991 is the formation stage of concept and connotation; WRCC is an application of the concept of natural carrying capacity in the field of water resources, was first proposed by the Research Panel of Water Resource Soft Science in Xinjiang [16]. From 1992 to 1999, it was the stage of theoretical exploration. Shi & Qu (1992) clearly put forward the concept of WRCC [17]. During 2000-2005 is the development stage of the method model; For example, the research methods of WRCC include principal component analysis
method, multi-objective planning method, fuzzy comprehensive evaluation method, systematic dynamics method, conventional trend method, osculating value method, etc. [1]. The advantages and disadvantages of these methods are shown in below table 1.

Although many researchers have been studying WRCC, the understanding and expression of the concept of WRCC have not been unified. At present, the concept of WRCC can be summarized into three standpoints: the first standpoint is the scale theory of water resources development, a number of researchers believe that WRCC is the largest scale of water resources exploitation according to the coordinated development of economy, society and ecological environment through water resources allocation under a certain level of productivity and scientific technology; The second standpoint is that water resources support the theory of sustainable development. It believes that water resources carrying capacity is based on the premise of maintaining a virtuous circle of ecological environment, based on a certain level of science and technology, WRCC is maximum support to sustainable economic and social development; The third standpoint is about WRCC refers to the premise of maintaining a virtuous cycle of ecological ecology and sustainable development under the conditions of specific technology and socio-economic development level in a certain historical stage, the scale of social and economic activities supported by the local water resources system and certain number of people [1,11,18-21].

Table 1. Advantages and disadvantages of different analysis methods.

| Methods                        | Advantages                                                                 | Disadvantages                                                                 |
|--------------------------------|---------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Principal component analysis method | 1. Objective determination of the weight of each index to avoid subjective arbitrariness  
2. The problem of integrability between indexes of different dimensions is solved | 1. It is difficult to choose the grading standard of evaluation parameters and the principal component  
2. The physical meaning of principal component is not clear; it is difficult to choose appropriate control points in economic activities |
| Multi-objective planning method  | 1. The study area is considered as a whole system  
2. The optimal state of the system under certain background conditions is achieved by mathematical programming | 1. The technical difficulties, such as the construction of the model and the effectiveness of the solution  
2. Limited to a small model size, the system cannot be considered more comprehensively |
| Fuzzy comprehensive evaluation method | 1. To deal comprehensively with the discrete process generated subjectively  
2. Comprehensive analysis of water resources carrying capacity | 1. Weeding small operations into large ones can lose a lot of useful information  
2. The information utilization of the model is low |
| Systematic dynamics method       | 1. The analysis speed is fast and the model construction is simple         | 1. Small perturbations of linear equation parameters may lead to absurdity of long-term analysis results |
| Conventional trend method        | 1. Easy operation;  
2. Visual display of content                                           | 1. There are many social factors involved and the relationship among them is complex  
2. There is a certain gap between the water resources carrying capacity obtained and the actual capacity |
| Osculating value method          | 1. Accurate purpose  
2. Rigorous logic  
3. Easy to calculate                                                       | 1. Only quantitative comparison can be made to the object of evaluation (water resources), which cannot meet the objective classification basis |

3. Case study

3.1. Study area

Aksu, latitude 39° 30′~ 41° 27′, longitude 79° 39′~ 82° 01′, is in western Xinjiang, with a total area of 18,369.9 km². Additionally, Aksu belongs to warm temperate arid climate region, there are three rivers in the city including Aksu New River, Old River and perennial non-freezing Doolang River with annual runoff of 11.4 billion m³ and groundwater reserves of 500 million m³ [5]. Figure 1 shows location of Aksu.
3.2. Data sources
There are mainly three data sources applied in this paper, Xinjiang Water Resources Bulletin (2015), Textile Industry Yearbook (2015) and Xinjiang Statistical Bureau (2015), which contain data of population (rural and urban), added value of industry, total volume of textile industry water computation, Gross Domestic Product (GDP), total volume of surface water resources and total volume of groundwater resources etc.

3.3. Methods

3.3.1. Osculating value method model. The osculating value method is an optimization method for multi-objective decision-making. Its basic idea is to integrate multiple target systems into a single goal that can measure the merits and demerits in order to optimize or rank. Generally, the specific method is to find out the optimal and inferior position of the decision alternatives after the normalization of all indicator values of decision alternatives, then calculate the distance between each the optimal and inferior point of decision alternatives, namely the osculation value [22]. The following part is calculation procedure:

Giving two finite groups \( A = [a_1, a_2, \ldots, a_m] \), \( G = [v_1, v_2, \ldots, v_n] \), where \( A \) stands for the aggregate composed of all the decision alternatives; \( G \) stands for the aggregate composed of all the evaluation factors. \( a_{ij} \) is the judge result of evaluation factor \( G_i \) to remark \( A_j \). Then the sets of total judgment factors \( m \) will create a judgment matrix \( A \).

\[
A = \begin{bmatrix}
    a_{11} & a_{12} & \cdots & a_{1n} \\
    a_{21} & a_{22} & \cdots & a_{2n} \\
    \vdots       & \vdots       & \ddots & \vdots \\
    a_{m1} & a_{m2} & \cdots & a_{mn} \\
\end{bmatrix} = (a_{ij})_{m \times n}
\]

(1)

However, indicators normally have a positive value (the larger value is better) and a reverse value (the smaller value is better). Moreover, the dimensions are different as well. For facilitating comparative analysis, therefore the reverse indicator should be turned into a positive indicator and the dimension also should be numerically converted to a dimensionless value. Assuming that:

\[
b_{ij} = \begin{cases} 
    a_{ij} & G_j \text{ is Positive indicator} \\
    -a_{ij} & G_j \text{ is Reverse indicator} 
\end{cases}
\]

(2)
\[ r_{ij} = \frac{b_{ij}}{\left( \sum_{i=1}^{m} b_{ij}^2 \right)^{\frac{1}{2}}} \quad (i = 1, 2, \ldots, m; j = 1, 2, \ldots, n) \] 

(3)

\( b_{ij} \) is the positive indicator value; \( r_{ij} \) is dimensionless value of indicator value.

From above, the numerical matrix \( B \) can be described as:

\[
B = \begin{bmatrix}
    b_{11} & b_{12} & \cdots & b_{1n} \\
    b_{21} & b_{22} & \cdots & b_{2n} \\
    \vdots & \vdots & \ddots & \vdots \\
    b_{m1} & b_{m2} & \cdots & b_{mn}
\end{bmatrix} = (b_{ij})_{mn}
\] 

(4)

Normalized indicator matrix \( R \):

\[
R = \begin{bmatrix}
    r_{11} & r_{12} & \cdots & r_{1n} \\
    r_{21} & r_{22} & \cdots & r_{2n} \\
    \vdots & \vdots & \ddots & \vdots \\
    r_{m1} & r_{m2} & \cdots & r_{mn}
\end{bmatrix} = (r_{ij})_{mn}
\] 

(5)

\( A_{ij} = (r_{i1}, r_{i2}, \ldots, r_{in}) \), \( i = 1, 2, \ldots, m \) stands for decision point.

The next procedure is about selecting the optimal or inferior point of decision point sets. The optimal and inferior point are the set of virtual points in extreme cases of each evaluation indicator of all decision point sets. The distance between each set of decision points and these virtual optimal/inferior points can be calculated, which can provide a quantitative basis for comprehensive evaluation of the decision alternatives.

The optimal/inferior point selection principle:

\[
r_j^+ = \max_{1 \leq i \leq m} \{ r_{ij} \}, \quad r_j^- = \min_{1 \leq i \leq m} \{ r_{ij} \} \quad (j = 1, 2, \ldots, n)
\] 

(6)

With respect to the decision point \( A_i \), \( i = 1, 2, \ldots, m \), the optimal/inferior points is:

\[ A^+ = (r_{1}^+, r_{2}^+, \ldots, r_{n}^+), A^- = (r_{1}^-, r_{2}^-, \ldots, r_{n}^-) \] 

(7)

Therefore, the osculating value of \( C_i \) for the decision point can be calculated as:

\[
C_i = \frac{d_i^+ - d_i^-}{d_i^+} \quad (i = 1, 2, \ldots, m)
\] 

(8)

\( C_i \) is the osculating value, which reflecting the degree to which the decision point \( A_i \) is close to the optimal point \( A^+ \) by far from the inferior point \( A^- \).

\( d_i^+ \) and \( d_i^- \) represent the Euclidean distance between decision points \( A_i \) and \( A^+ \) / \( A^- \) respectively. \( d^+ \) and \( d^- \) represent the minimum value of \( m \) optimal distance and the maximum value of \( m \) worst distance respectively.

\( d_i^+ \), \( d^+ \), \( d_i^- \), \( d^- \) are calculated by following formula:

\[
d_i^+ = \left( \sum_{j=1}^{n} \omega_j (r_{ij} - r^+_{ij})^2 \right)^{\frac{1}{2}}, d^+ = \min_{1 \leq i \leq m} \{ d_i^+ \}
\] 

(9)

\[
d_i^- = \left( \sum_{j=1}^{n} \omega_j (r_{ij} - r^-_{ij})^2 \right)^{\frac{1}{2}}, d^- = \max_{1 \leq i \leq m} \{ d_i^- \}
\] 

(10)

\( \omega_j \) is the weight of \( j \) indicator.

Finally, sorting by \( C_i \)’s value. \( c_i = 0 \), which means that is the optimal decision point. \( c_i \leq 0 \), which means deviating from the optimal decision point, the better evaluation result demands a smaller value of \( c_i \).
3.3.2. Selecting, gradating and weighting of evaluation factors. Selecting Evaluation Factors. To evaluate the regional WRCC, it is necessary to establish a set of criteria systems [23, 24]. There are different ways to choose the evaluation indicator of WRCC. Generally, indicators are divided into macro indicators and comprehensive indicators, which correspond to the population bearing water resources and industrial scale; While macro indicators describe the economic scale and population supported by the availability of regional water resources, the comprehensive indicators represent the supporting capacity of water resources [15]. In addition, the design of WRCC evaluation criteria system should follow the principles of systematic and hierarchical combination; unity of completeness and independence; optimization of cross-indicators and comprehensive indicators; feasibility and operability [25].

In this paper, Aksu area is the base of cotton planting and cotton textile industry. The local textile industry not only meets the market demand, but also solves the employment problem of residents. However, with the rapid growth of agricultural irrigation water in recent years, water resources have acted as an increasingly prominent role in restricting the development of textile industrial base. Consequently, the primarily affecting factors of WRCC in Aksu’s textile industry include the development and utilization level of water resources, the economic development level of textile industry base, the social development level of textile industry base and the ecological environment of textile industry base.

According to the principles established by the above indicator system and the main influencing factors of WRCC of textile industrial base, the evaluation indicator system of WRCC of textile industrial base is show in Table 2. The target layer (Z) is reflected by the criterion layer (C₁, C₂, C₃) and the criterion layer by the indicator layer (x₁ ~ x₇).

| Table 2. The indicator system of water resources carrying capacity. |
|---------------------------------------------------------------|
| **WRCC (Z)** | **Water Resources System (C₁)** | The ratio of total water consumption to red line indicators (x₁) |
| | | The ratio of groundwater to water supply (%) (x₂) |
| | | Per unit area of water resources (m³/km²) (x₃) |
| **Social System (C₂)** | Urbanization rate (%) (x₄) |
| **Economic system (C₃)** | Per capita water consumption (m³) (x₅) |
| | 10,000 Yuan of industrial output value of water demand (m³/104 Yuan) (x₆) |
| | Comprehensive agricultural irrigation quota (m³/mu) (x₇) |

3.3.3. Gradating of evaluation factors. By referencing indication system in the National Water Supply Demand Balance Analysis, incorporate with the characteristics of Aksu’s textile industrial base, the evaluation indicators are classified into three grades which are expressed as V₁, V₂ and V₃. Clearly, the grade of V₁ represents WRCC of textile industrial base in good situation where water resources have favourable exploitive potential; the grade of V₂ indicates the development and utilization of water resources which has reached a considerable scale and WRCC has exceeded the saturation value and there is no development potential. The standard value of these three grades are shown in Table 3.

| Table 3. The standard value of evaluation indictors. |
|---------------------------------------------------------------|
| **Indicators** | **V₁** | **V₂** | **V₃** |
| The ratio of total water consumption to red line indicators | <0.8 | 0.8~1 | >1 |
| The ratio of groundwater to water supply (%) | <4 | 4~14 | >14 |
| Per unit area of water resources (m³/km²) | >100 | 38~100 | <38 |
| Urbanization rate (%) | <16 | 20~50 | >50 |
| Per capita water consumption (m³) | <400 | 400~800 | >800 |
10,000 Yuan of industrial output value of water demand (m$^3$/104 Yuan) | <20 | 20~72 | >72
Comprehensive agricultural irrigation quota (m$^3$/mu) | <270 | 270~520 | >520

3.3.4. Weighting of evaluation factors. Based on the research of Wang & Guo (2019), who adopt Analytic Hierarchy Process (AHP) to calculate indicator’s weight [26], this paper will use this method to weight indicators as well. AHP refers to a system that includes a multi-objective decision-making problem, by decomposing the total goal into several small goals and establishing the judgment matrix, the weights of each indicator can be calculated. Table 4 shows the indicator’s weighting.

| Criterion layer | Weighting | Indicator layer | Weighting |
|-----------------|-----------|----------------|-----------|
| Water resources system | 0.600 | The ratio of total water consumption to red line indicators | 0.500 |
| Social system | 0.200 | The ratio of groundwater to water supply (%) | 0.050 |
| | | Per unit area of water resources (m$^3$/km$^2$) | 0.050 |
| | | Urbanization rate (%) | 0.100 |
| | | Per capita water consumption (m$^3$) | 0.100 |
| Economic system | 0.200 | 10,000 Yuan of industrial output value of water demand (m$^3$/104 Yuan) | 0.050 |
| | | Comprehensive agricultural irrigation quota (m$^3$/mu) | 0.150 |

4. Results and analysis
By establishing the matrix of evaluation indicators, the value of each evaluation indicator in table 5 and the standard value of evaluation indicators are inputted.

| Administrative Region | Indicator layer | Index |
|-----------------------|----------------|-------|
| Aksu                  | The ratio of total water consumption to red line indicators | 1.092 |
| | The ratio of groundwater to water supply (%) | 6.9 |
| | Per unit area of water resources (m$^3$/km$^2$) | 5.89 |
| | Urbanization rate (%) | 32.8 |
| | Per capita water consumption (m$^3$) | 3967.9 |
| | 10,000 Yuan of industrial output value of water demand (m$^3$/104 Yuan) | 74.4 |
| | Comprehensive agricultural irrigation quota (m$^3$/mu) | 709.0 |

The matrix R can be calculated according to equations (1) – (5). After selecting the optimal and inferior point and calculating the Euclidean distance of optimal and inferior points through the equations (6) – (7), finally, the osculating value ($C_i$) is shown as follow (Eq. (11)):

$$C_i = (10.955, 0, 2.809, 5.987)$$

Then, $C_i$ will be sorted by value. When $C_i = 0$, it is the optimal point. There is a principle of ranking the $C_i$ value that the closer of $C_i$ value to 0, the better the decision point. Therefore, the osculating value of Aksu’s textile industry base is 10.955; the standard value of $V_1$ is 0~2.809; the standard value of $V_2$ is 2.809~5.987; the standard value of $V_3$ is exceeding 5. 987. The result indicates that WRCC of Aksu’s textile industrial base belongs to Grade $V_3$, and WRCC has exceeded the saturation value, which means there is no development potential of water resources.
From the above analysis, the total volume of water consumption of textile industry and the agricultural irrigation water consumption are the directly dominating factors that cause the WRCC overload in Aksu’s textile industrial base. Moreover, Aksu is the major printing and dyeing area of Xinjiang’s textile industry, contributing to a great amount of water consumption. In addition, Xinjiang is China’s largest cotton growing base with nearly 4.2 million tons (2015) of total cotton output in the whole Xinjiang area among which Aksu accounted for approximately 20%. This means considerable amounts of water resources were consumed by agricultural irrigation. The value of WRCC increased, eventually causing overload of the regional WRCC.

Apparentl
y, an overloaded WRCC in Aksu’s textile industry base would affect economic development. By the abundant cotton resources and a large number of preferential policies, Aksu's textile industry has developed rapidly and stimulated economic development greatly. Once the economic development is affected, it will inevitably lead to the difficult operation of textile factories, a large number of layoffs, affecting social stability. Furthermore, an overload of WRCC generally means that the ecological environment is destroyed to some extent. Textile industry is one of the industrial sectors with large water consumption and waste water discharge. Textile industry wastewater generally contains suspended matter, grease, fiber chips, surfactants and various dyes, for example, the printing and dyeing wastewater contains slurry, dyes, additives and a variety of organic matters. To change the current overload of WRCC in Aksu’s textile industry base, improving the efficiency water resources use is one of solution. There are two ways to increase water use efficiency. Firstly, cotton is an important raw material for textile industry, by improving irrigation technologies could reduce water resources demand. Secondly, improving the production engineering, adopting water saving equipment, that could reduce water consumption.

The further researches that can be done in Aksu’s textile industry base are the analysis of water reuse rate and the water saving technology of production equipment of textile industry. Water reuse rate is a comprehensive research index and an important consideration factor for water efficiency improvement, including technology level, management ability and water-saving evaluation, its research purpose can promote textile production enterprises to adopt advanced production technology, process and equipment [27]. Additionally, the study of water reuse rate in textile industry is directly related to water use efficiency and discharge of water pollutants, it is of great significance to understand the water use status and tap the water saving potential of the industry.

5. Conclusions
This paper evaluated the WRCC of Aksu’s textile industry base by analyzing the development and utilization of water resources via implementing osculating value method and Analytic Hierarchy Process to account the value of WRCC. Osculating value method is an optimal method for multi-objective decision making. Its basic idea is to synthesize multiple objective systems into a single objective that can measure the advantages and disadvantages on the totality level in order to select the preference or rank. The specific method is to normalize all the decision index values, find out the position of the optimal point and the worst point of the decision scheme, then calculating the distance (Osculating value) between each scheme and the optimal point or the worst point, the next step is rank the pros and cons of each decision scheme. Finally, converting multiple indicators into a single comprehensive value for evaluation. The decision process of osculating value method is simple and fast, which can solve the difficult problem of gray theory and fuzzy mathematics. The result shows that the WRCC of textile industry base is severely overloaded in 2015. With further aggravate the imbalance between supply and demand of water resources, water resources shortage has become a major bottleneck restricting the development of urban social economy. An overload WRCC means that the social and economic scale does not match the natural endowment condition of water resources and the water ecology and water environment have deteriorated. Due to the special natural and geographical conditions of arid and semi-arid areas in the northwest of China combining with the background of the Belt and Road Initiative in the western China, the sustainable development of the region can be achieved by well coordinating the systematic problem of water resources—ecological environment—social economy—population. Water
resources are scientifically allocated and rationally utilized and the WRCC is significantly improved. Therefore, conducting the research of WRCC on the industrial bases of northwestern region has profound scientific and practical significance.

There are some suggestions for Aksu government.

a. Agricultural administrative departments should maintain or even increase the planting area of cotton in local area, ensuring the effective supply of cotton and reducing the risk impact of excessively high raw material prices on the whole textile and garment industry chain. At the same time, training, education and experience exchange are actively carried out to guide cotton farmers to optimize planting varieties, improving cotton plant survival rate and irrigation efficiency.

b. Relevant administrative departments of textile industry should guide the optimization and upgrading of local textile industry based on industrial reality. Intensifying policy guidance, improving the business environment. Strengthening construction planning constraints, the scale of new projects, site selection and supporting role for industrial development should meet the market demand and environmental carrying capacity.

c. While ensuring the water demand for cotton irrigation in Aksu, the water conservancy management departments should improve field irrigation technology, adopt sprinkler irrigation and drip irrigation technology moderately, encouraging the development of various inadequate irrigation technologies in water-deficient areas and improving the water efficiency of cotton.

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