The Intervention Plan of Water Resource

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Abstract. First, I establish the L-WSCI model to compare water resource. There are 5 differentfeasible and efficient intervention plans: Water Project——south-to-north water diversion, desalination of sea water, recycled water treatment technologies,technology of drop Irrigation and urban greenbelt. We take all of 5 plans into consideration. Even so, which maximizes the water supply, the situation of water scarcity could only relieve tension and stress but could not solve this problem thoroughly. These results imply that the chosen region is an absolute scarcity area. Finally, we use the data in Task 2 forecast the water resource situation in next 15 years. The results show that there is little possibility that water would become a critical issue in the future.

Introduction

I choose one of the absolute scarcity region——Tianjing as the study region.Tianjin is a metropolis in coastal northeastern China and one of the five national central cities of China, with a total municipal population of 15,200,000. It is governed as one of the four direct-controlled municipalities of the PRC and is thus under direct administration of the central government. Tianjin borders Hebei Province and Beijing Municipality, bounded to the east by the Bohai Gulf portion of the Yellow Sea. Part of the Bohai Economic Rim, it is the largest coastal city in northern China. In terms of urban population, Tianjin is the fourth largest in China, after Shanghai, Beijing, and Guangzhou. In terms of administrative area population, Tianjin ranks fifth in Mainland China. But compared to other regions,Tianjing is a thirsty place.

The L-WSCI Model

The L-Wsci Model could be described byequation.

$$W_{sci} = \left(\frac{4000 * \alpha}{\left(\frac{100}{100-p}\right) \beta e^{\lambda t} (\varepsilon + \gamma + \delta) \left(\frac{100}{100-\kappa}\right) + h + b} \right)$$

Then we use the data to check the Model, The results are shown in Table1.

Table1:Modified Data

Hainan	Anhui	Hunan	Yunnan	Kweichow	Honan
0.53	4.84	4.93	7.27	18.30	27.52
Shangtung	**Kansu**	**Chungking**	**Inner Mongolia**	**Tianjing**	
30.64	42.14	66.40	146.90	360.34	

In order to make the result more obvious based on the value of the L-Wsci Model and the real water resource situation we found on the website of the ministry of water resources of the Peoples Republic of China. The water conditions in an area can be categorized as: no stress, stress, scarcity, and absolute scarcity (Table2).

Table2:Classification

L − Wsci	**Condition**
<10	No Stress
10-20	Stress
20-40	Scarcity
>40	Absolute Scarcity

From the Table2, we can find that in most areas, namely, Inner Mongolia, Tianjing andKansu, (Figure 1)the model fits well to the real data of UN water scarcity map.

The Intervention Plan

The Analysis of Intervention Plan. In The L-Wsci Model, some of the parameters could change due to infrastructures, (for example, desalinization plants, water harvesting techniques or undiscovered aquifers),for example $b, k, p, h, \beta, \lambda$, while others could not, for example $\alpha, \varepsilon, \gamma, \delta$ .In order to make a better environment in the study region in future, we try our best to make the optimum solution in the changeable parameters by intervention plan.

Details about the Projects. There are 5 different feasible and efficient techniques : Water Project——south-to-north water diversion, desalination of sea water, recycled water treatment technologies, technology of drop Irrigation and urban greenbelt.

According to the data from Water Affairs Bureau of Tianjing, these methods could be used in the near future and the quantized effects of these projects could be found the technical papers which are shown in the following table(table 3).

Table 3: Effect of different intervention plans

Intervention Plan	**Effect**
south-to-north water diversion	+7.6
desalination of sea water	+0.175
recycled water treatment technologies	+1.5
technology of drop Irrigation	-10%
urban greenbelt	---

We plunge these parameters of 2012 into theequation, then we obtain the different index of The L-Wsci Model and following table shows the results(table 4).

Table 4: the Results with intervention plans

Before optimization	**After optimization**	**Change Rate**
265.8324	245.5478	-7.63%

From the Table 4, we can find that even if the study object implements the ideal intervention plan, which maximizes the water supply, the situation of water scarcity could only relieve tension and stress but could not solve this problem thoroughly. The urban greenbelt does not affect the quantity of clean water directly. It effects the water circulation. It would be easier that atmospheric rainfall turn into ground water when there is more urban greenbelt in a region, especially for the area like Tianjing.

We assume that there is a soar in urban greenbelt. Then we calculate the results and that is shown below (table 5).

Table 5:AssumptionSimulation

γ=30m^2	**Change Rate**	**γ=50m^2**	**Change Rate**	**γ=77.7m^2**	**Change Rate**
222.7102	16.22%	202.3631	23.88%	180.1445	32.23%

We could find that it is an efficient way to mitigate water scarcity by improving the area of urban greenbelt. But it cannot the situation that the region is acute shortage of water. Besides, there is no evident or papers that prove the intervention plan have a negative impact on the surrounding areas or the entire water ecosystem.

The Future

I assume that effects of the intervention plans mentioned before is constant during our study time. I add these new water resources to the results. And according to these data, we calculate the final result and the following table shows that (table 6).

Table 6:Final Results

Year	Before optimization	After optimization	change rate
2016	265.1381017	255.9770343	-3.46%
2017	273.2052693	263.4070261	-3.59%
2018	280.4845849	270.3443767	-3.62%
2019	287.4083346	277.0732598	-3.60%
2020	296.7816982	285.4985592	-3.80%
2021	308.2645285	295.4010341	-4.17%
2022	320.2620024	305.7004982	-4.55%
2023	332.004405	315.8801674	-4.86%
2024	314.3587476	297.9423621	-5.22%
2025	320.4671663	302.5952877	-5.58%
2026	327.535705	307.8999894	-5.99%
2027	333.0701495	312.1925797	-6.27%
2028	339.414889	317.0412956	-6.59%
2029	332.7683435	313.053324	-5.92%
2030	339.2988182	318.0426104	-6.26%

According to the results, as the similar results in Task 4, the chosen region nearly could not become less susceptible to water scarcity in the future. But it is worth to implement the intervention plan for reliving the water stress. In the meantime, It is important to note that the through solutions deserve attention. As time goes by, the situation gets worse, we cannot predict it very accurate and we believe the key reason lies in the lack of data. In other words, we only get the data from 2000 to 2012. So the thirteen-year data is too less to forecast the thirteen-year trends of future and the exact results is based on the fact that we have get the data of past forty or fifty years.

Then we take **γ** into considerations and following table shows the results (table 7).

Table 7: Final Result with Impact of **γ**

γ=30m^2	**Change rate**	**γ=50**m^2	**Change rate**	**γ=77.7**m^2	**Change rate**
308.907	-15.70%	280.5292	-23.44%	248.8652	-32.08%
329.8444	-12.66%	299.9228	-20.59%	266.4466	-29.45%
354.8583	-12.09%	321.2266	-20.42%	283.9538	-29.65%
231.9839	-12.50%	209.7671	-20.88%	185.2021	-30.15%
241.1795	-11.72%	218.0362	-20.19%	192.458	-29.56%
250.6467	-10.64%	226.5493	-19.23%	199.9278	-28.72%
260.3886	-9.40%	235.3094	-18.13%	207.6145	-27.76%
270.408	-8.89%	244.3193	-17.68%	215.5206	-27.38%
280.7073	-8.94%	253.5814	-17.74%	223.6486	-27.45%

291.2881	-9.05%	263.0976	-17.85%	232.0005	-27.56%
302.1515	-8.99%	272.8692	-17.81%	240.5778	-27.54%
286.231	-8.95%	258.403	-17.80%	227.7376	-27.55%
291.4951	-9.04%	263.1079	-17.90%	231.838	-27.66%
297.558	-9.15%	268.4692	-18.03%	236.4543	-27.81%
303.0417	-9.02%	273.3648	-17.93%	240.7157	-27.73%
308.5931	-9.08%	278.3217	-18.00%	245.0315	-27.81%
306.0672	-8.02%	276.0198	-17.05%	242.9819	-26.98%
311.6265	-8.16%	280.9857	-17.19%	247.3072	-27.11%

Summary

According to the results, as the similar results above, the situation in Tianjing greatly improved due to the increase area of urban greenbelt. But it still belongs to the Absolute Scarcity Region.

In conclusion, it is intervention plan that improve the water scarcity in Tianjing, but all of the techniques could not change the status of absolute scarcity.

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