Supplement S1

Table S1. Current WRCC calculation method.

Methods	Reference (s)	Study area	Main research content
Error back propagation model	[60]	Guanzhong Plain in Shaanxi Province	Evaluating the Water Resource Carrying Capacity of the Guanzhong Plain in Shaanxi Province from 2000 to 2009.
Matter element analysis	[61]	The north of anhui province	Comprehensive evaluation of the sustainable utilization status of water resources in the northern Anhui region.
Grey clustering	[62]	Chongqing	Obtain the objective evaluation results of water resources carrying capacity.
State-space method	[63]	Beijing Tianjin Hebei	A comprehensive carrying capacity evaluation system was constructed based on state space methods and component analysis from four aspects: economy, environment, ecology, and energy.
Support vector machines	[64]	Kaifeng	Established a new support vector machine based water resource carrying capacity model.
Analytic hierarchy process	[65]	Siping District, Jilin Province	A comprehensive evaluation index system and system dynamics simulation model for regional water ecological carrying capacity (WECC) were established by combining System Dynamics (SD) and Analytic Hierarchy Process (AHP).
	[66]	Shendong and Yili mining areas	Constructed an evaluation system for MAWRCC under mining action, analyzed the main influencing factors and membership functions of MAWRCC evaluation.
Set pair analysis	[67]	12 farms of Hongxinglong Branch of Heilongjiang	Using set pair analysis technology to evaluate the carrying capacity of water resources.

		Development Bureau	
Multi-objective programming model	[68]	Tongzhou, Beijing	Provided an imprecise fuzzy multi-objective programming model (IFMOP) based on environmental carrying capacity to solve industrial structure optimization problems.
Metabolic theory	[38]	Wuwei city	Introducing the concept of biological metabolism into regional water resource carrying capacity and proposing a regional water resource metabolism theory.
Ecological footprint	[69]	Chang-zhu-tan region	Analyzed the utilization of water resources.
	[70]	Beijing	Based on the analysis of wetland water resource systems, a system dynamics (SD) model for water resource carrying capacity was established.
	[71]	Liupanshui	Starting from the three dimensions of life, production, and ecology, an ecological footprint and ecological carrying capacity model for water resources was established based on the ecological footprint theory.
	[72]	Zhangjiakou	The water ecological footprint model combined with system dynamics model was used to evaluate the carrying capacity and sustainability of water resources.
	[73]	Yinchuan	A method for calculating water resource carrying capacity (WRCC) and water environment carrying capacity (WECC) has been proposed to evaluate the economic and population scale that a region can support.
System dynamic model	[74]	Tieling	Using System Dynamics, Artificial Neural Networks (ANN), and CA Markov Models to Establish Water Ecosystem Models.

	[75]	liaohe river basin	Developed a WECC evaluation method based on system dynamics framework (WECC-SDM).
	[76]	Tianjin	Using a system dynamics model for solution. The water resource system is divided into six subsystems, which are interrelated. To analyze the relationships between all factors in the subsystem and establish dynamic equations to quantify the problem.
	[77]	Pakistan	Two models were proposed. The first model is the application of system dynamics in the field of water resources, and the second model is the evaluation model.
	[78]	Beijing Xiong'an New Area	A System Dynamics (SD) model was established to evaluate the carrying capacity of regional water resources, and several scenarios were designed: original development scenario, accelerated industrial development scenario, environmental governance scenario, and optimal development scenario.
Catastrophe theory	[79]	People's Victory Canal Irrigation District	A groundwater environmental carrying capacity evaluation index system was established based on the inherent hierarchical relationship of each indicator, and it was divided into several subsystems. By normalizing the indicator effects based on disasters, the impact of each indicator on the carrying capacity system was obtained. The method based on fuzzy membership function disaster evaluation values explains the carrying capacity of groundwater environment.
	[80]	Hubei	Established an improved disaster progression method based on M-K test and correlation analysis.

Cloud model	[81]	Heilongjiang	The initial value is obtained using the fuzzy comprehensive weighting method. Using cloud models to objectively generate WRCC evaluation levels and analyzing the temporal and spatial evolution of the study area.
Neural network	[82]	Hefei	An iterative method was proposed, which combines the advantages of backpropagation (BP) in weight learning and the ability of genetic algorithms in searching for solutions to predict urban water demand.
	[83]	Huaihe River Basin	A new method combining improved genetic algorithm and artificial neural network has been proposed for evaluating the carrying capacity of water resources.
GRA-TOPSIS	[84]	Shihezi	Quantify the WRCC of Shihezi, an oasis city in the Manas River Basin.
RBF neural network model	[85]	Yellow River basin	Research on the Water Resources Carrying Capacity of the Yellow River Basin.
Fuzzy comprehensive evaluation model	[86]	City on the northern slope of Tianshan Mountains	Quantitative assessment of water resource carrying capacity.

Table S2. Index system for water resource carrying capacity of 11 provinces and cities in the Yangtze River Economic Belt.

Standard Layer	Index	Index Layer	Notation	Unit	Indicator type
Water Resource Subsystem	Outcome subsystem	Total water resources	Reflecting natural runoff	$10^8 m^3$	P
		Average annual water production modulus	Reflecting the water supply capacity	$10^4 m3/km^2$	P

		Per capita water resources	Reflecting the water scarcity status and development potential	m^3/person	P
		Annual precipitation	Reflecting the natural precipitation status	mm	P
Ecological Environment Subsystem	Condition subsystem	Proportion of ecological water	Reflecting the demand for water resources in the ecosystem	%	P
		COD emissions	Measuring the degree of organic matter pollution in water bodies	t	N
		Forest coverage rate	Reflecting the ability of forests to purify water	%	P
		Per capita park green space area	Reflecting the level of urban greening	m^2	P
Social Subsystem		natural population growth rate	Reflecting the adequacy of water resources	‰	P
		Per capita domestic water consumption	Regional water resource management capability	L	N
		Total population	Reflecting the regional population	10^4 people	N
		Total sewage treatment capacity	Reflecting wastewater treatment capacity	10^4t/(d)	P
Economic Subsystem		Per capita regional GDP index	Reflecting water stress caused by industrial output	last year=100	P
		Total water-saving irrigation area	Reflecting agricultural water-saving capacity	10^3hm^2	P

Industrial Water	Reflecting water stress caused by industrial output	10^8m3	P
The proportion of primary industry GDP to the total GDP	Reflecting the richness of regional water resources	%	P

Note: P represents a positive indicator, and the larger the value of this indicator, the higher the overall score of the subsystem. N represents a negative indicator, and the larger the value of this indicator, the lower the overall score of the subsystem.

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