water

MDPI

Article

Analysis of Water Environment Quality Changes and Influencing Factors during the "Thirteenth Five-Year Plan" Period in Heilongjiang Province

Wei Chen [1,†], Yu Bai [2,†], Bo Li [1,*], Chengcheng Feng [1,*] and Mi Zhou [3]

SUPPORTING INFORMATION

Some terms mentioned in this article come from the "Environmental quality standards for surface water" (GB 3838-2002) issued and implemented by the Ministry of Ecology and Environment of the People's Republic of China.

In this standard, surface water is divided into five categories according to the environmental functions and protection objectives of surface water waters. They are:

Class I: Mainly applicable to source water and national nature reserves.

Class II: Mainly suitable for the first-class protected areas of surface water sources of centralized drinking water, habitats for rare aquatic organisms, spawning grounds for fish and shrimp, and feeding grounds for juveniles and juveniles.

Class III: Mainly used in secondary protected areas of centralized drinking water surface water sources, wintering grounds for fish and shrimp, migratory passages, aquaculture areas and other fishery waters and swimming areas.

Class IV: Mainly suitable for general industrial water areas and recreational water areas that are not in direct contact with the human body.

Class V: Mainly applicable to agricultural water areas and waters with general landscape requirements.

Among them, the water quality of Class I is good. The groundwater only needs to be disinfected, and the surface water can be used for drinking after simple purification treatment (such as filtration) and disinfection. Class II water quality is slightly polluted, and after conventional purification treatment (such as flocculation, sedimentation, filtration, disinfection, etc.), it can be used for drinking. Class III water quality can also be used for daily drinking after treatment. The water quality below class IV is poor and cannot be used as a source of drinking water.

In addition, class I, II, and III water are classified as water bodies with good water quality, and the ratio of the number of surface water monitoring points reaching Class I, II, and III to the total number of surface water monitoring points is calculated as follows:

Proportion of excellent water quality (%) = the number of monitoring points whose surface water quality reaches Class I, II, and III / the number of all monitoring points × 100%

Corresponding to the above-mentioned five types of water functions of surface water, the standard values of the basic items of the surface water environmental quality standard are divided into five categories, and the standard values of the corresponding categories are respectively implemented for different functional categories (see Table 1). The standard value of high-water area function category is stricter than the standard value of low water area function category. If there are multiple types of use functions in the same water area, the standard value corresponding to the highest function type shall be implemented. The realization of water function and the function category standard have the same meaning.

Table S1. Basic items of surface water environmental quality※ Standard limit.

(Unit: mg/L)

Classification Limit Item	Class I	Class II	Class III	Class IV	Class V
Smectite index	2	4	6	10	15
Chemical oxygen demand	15	15	20	30	40
Ammonia nitrogen	0.15	0.5	1.0	1.5	2.0
Total phosphorus	0.02	0.1	0.2	0.3	0.4

※Only the indicators mentioned in this article are listed in the table.

Table S2. Grey correlation degree and ranking of surface water environmental quality comparison series.

Category.	Correlation Factor Type (subclass)	Permanganate Index	Chemical Oxygen Demand	Ammonia Nitrogen	Total Phosphorus	Proportion of Excellent Water Quality
Climate	Average temperature (℃)	0.751(17)	0.759(16)	0.721(17)	0.716(17)	0.778(17)
	Average annual precipitation (mm)	0.786(15)	0.808(11)	0.702(18)	0.685(19)	0.726(19)
	Annual sunshine hours (h)	0.891(7)	0.908(3)	0.794(15)	0.778(15)	0.87(2)
Population	Population of Heilongjiang Province (10,000 people)	0.917(2)	0.89(5)	0.851(10)	0.836(9)	0.867(4)
Economics	GDP per capita (yuan/person)	0.888(8)	0.902(4)	0.771(16)	0.756(16)	0.832(8)
	The primary industry	0.897(6)	0.89(6)	0.852(9)	0.827(11)	0.89(1)
	The secondary industry	0.814(14)	0.793(15)	0.808(14)	0.812(12)	0.817(13)
	The tertiary industry	0.925(1)	0.939(1)	0.81(13)	0.792(14)	0.867(3)
	Local fiscal expenditure on environmental protection (100 million yuan)	0.593(21)	0.598(21)	0.579(20)	0.567(20)	0.748(18)
Energy	Elasticity coefficient of energy consumption	0.663(19)	0.67(19)	0.68(19)	0.696(18)	0.677(20)
water resource	Surface water resources (100 million m^3)	0.603(20)	0.612(20)	0.546(21)	0.540(21)	0.627(21)
	Total surface water supply (100 million m^3)	0.901(4)	0.877(8)	0.912(1)	0.882(1)	0.842(7)
	Total groundwater supply (100 million m^3)	0.774(16)	0.757(17)	0.875(7)	0.853(7)	0.811(14)
	Total agricultural water consumption (100 million m^3)	0.828(10)	0.809(10)	0.893(5)	0.874(5)	0.829(10)
	Total ecological water consumption (100 million m^3)	0.489(22)	0.485(22)	0.502(22)	0.528(22)	0.496(22)
	Water consumption per capita (m^3 / person)	0.846(9)	0.825(9)	0.9(3)	0.881(3)	0.829(9)
Forestry	Artificial afforestation area in the current year (1000 hectares)	0.899(5)	0.919(2)	0.821(11)	0.805(13)	0.823(11)
Agriculture	Application amount of agricultural nitrogen fertilizer (10000 tons)	0.816(12)	0.798(13)	0.905(2)	0.881(2)	0.804(16)
	Application amount of agricultural phosphorus fertilizer (10000 tons)	0.817(11)	0.798(12)	0.889(6)	0.871(6)	0.843(6)
	Application amount of agricultural potassium fertilizer (10000 tons)	0.814(13)	0.796(14)	0.899(4)	0.876(4)	0.806(15)
	Application amount of agricultural compound fertilizer (10000 tons)	0.904(3)	0.879(7)	0.854(8)	0.852(8)	0.85(5)
	Agricultural compound fertilizer application pure volume	0.731(18)	0.716(18)	0.813(12)	0.830(10)	0.818(12)