

太湖蠡河小流域水质的空间变化特征及污染物源解析

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摘要: 为了解太湖流域河流中污染物的来源及时空变化特征, 于 2014 年在太湖湖西区蠡河小流域开展水质监测, 对从上游到下游的 5 个监测点汛期和非汛期水体中的总磷 (TP)、氨氮 ($\text{NH}_4^+ - \text{N}$)、化学需氧量 (COD) 浓度的变化规律及其影响因素进行了研究. 结果表明, 监测期间流域水体中 TP、 $\text{NH}_4^+ - \text{N}$ 、COD 的浓度均值为 0.176、1.075、10.626 $\text{mg} \cdot \text{L}^{-1}$, 水质状况总体较好, 未超过 IV 类水标准. 从上游到下游 TP、 $\text{NH}_4^+ - \text{N}$ 浓度逐渐升高, 下游水质较差, 均属于劣 V 类水质; 而 COD 浓度较低, 未超过 IV 类水标准. 受降雨的影响, 污染物浓度在汛期略高于非汛期. 在非汛期, 污染物浓度从上游到下游逐渐升高, 而在汛期, 各监测点污染物浓度没有明显的变化趋势. 随着居民地面积的增加, 林地面积的减少, 污染物浓度逐渐升高. 流域人口密度、畜禽养殖与水体中污染物浓度显著相关. 蠡河流域农业面源污染的主要来源是生活源和畜禽养殖源.

关键词: 面源污染; 污染物流失特征; 总磷; 氨氮; COD; 源解析

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Analysis of Spatial Variability of Water Quality and Pollution Sources in Lihe River Watershed, Taihu Lake Basin

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Abstract: The source of pollutants in the Tai Lake basin and the characteristics of spatiotemporal variations were studied by conducting water quality monitoring in the Lihe River watershed to the west of Tai Lake in 2014. The dynamic changes in total phosphorus (TP), ammonia nitrogen ($\text{NH}_4^+ - \text{N}$), and chemical oxygen demand (COD) were studied in flood and non-flood seasons at five monitoring points from upstream to downstream. The average concentrations of TP, $\text{NH}_4^+ - \text{N}$, and COD were 0.176 $\text{mg} \cdot \text{L}^{-1}$, 1.075 $\text{mg} \cdot \text{L}^{-1}$, and 10.626 $\text{mg} \cdot \text{L}^{-1}$ respectively, and the water quality was lower than the grade IV standard. From upstream to downstream, the concentrations of TP and $\text{NH}_4^+ - \text{N}$ gradually increased. The water quality downstream was poor, worse than the grade V standard; however, COD was low and met the grade IV standard. During the non-flood season, the pollutant concentrations gradually increased from upstream to downstream. There was no obvious trend in flood season. Concentrations of pollutants gradually increased with the increase in the area of inhabited land and decrease in the area of forest land. The population density, livestock, and poultry production were significantly correlated with the concentrations of pollutants in the river. The pollutants in the Lihe River watershed mainly originated from human activities, and livestock and poultry breeding activities.

Key words: non-point source pollution; dynamic characteristics of pollutants; TP; $\text{NH}_4^+ - \text{N}$; COD; pollutant source analysis

太湖流域作为我国比较发达的地区, 随着社会经济的发展和水质日益恶化, 湖泊富营养化加重, 蓝藻频发, 严重影响流域的可持续发展和居民的健康^[1, 2]. 从 20 世纪末开始, 国家在太湖流域的治理上投入了大量的人力、物力和财力, 工业源污染得到有效控制, 农业面源污染与水质的矛盾越来越突出^[3]. 在第一次全国污染源普查公报中显示, 来自农业源的总氮、总磷占到排放总量的 57.2% 和

67.4%^[4]. 太湖流域位于长江三角洲, 具有典型的平原水网特征, 地势平坦, 河网密布, 水系复杂, 污染的流失方向和汇流边界难以确定^[5, 6], 工业密集, 农

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