

Research on Major Causes of Eutrophication in Poyang Lake

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China

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1. Abstract

Poyang Lake is the biggest freshwater lake in China. However, it was plagued with numerous ecological problems for years. One of them is eutrophication, which was mainly caused by excessive amount of nitrogen and phosphor in the water and leads to the growth of algae and other kinds of plants and plankton. When these organisms are alive, they will block sunlight, absorb oxygen and sometimes release toxic substances, wiping out other plants and animals. After they die, the chemicals that build up in their bodies continue to exist and cause eutrophication. Like many others, we wonder what factors lead to Poyang Lake's eutrophication. In order to find out about the answer, we listed some possible factors, and then went online to research for some information and data related to those factors. Eventually, we found out several factors including farming fertilizer and factory waste water disposal that lead to Poyang Lake's eutrophication.

2. Keywords

Eutrophication; Poyang Lake; Chemicals; Plankton; Wastewater discharge

3. The purpose of the research

Looking at the Poyang Lake right now, we feel kind of terrible for its current state. Many people, such as students from universities in China and some academic researchers have done numerous research and report about Poyang Lake, and we care about this beautiful lake as much as they did. We want to make what little contribution we can in hope that one day the lake will be restored to its former beauty. Our research will possibly give those environmentalist or the ones who are trying to clean up Poyang Lake a better idea about what aspect they need to pay attention to. Therefore, we started from figuring out what factors caused the eutrophication of Poyang Lake.

4. Method of the research

We searched the internet step by step. First, we searched for the main causes of eutrophication, which is due to too much nitrogen and phosphor in the water. Then we started searching for data related to local factories' waste water disposal, and in the meantime, we also searched for the amount of nitrogen and phosphor in popular fertilizers that are used in China. We also collected the data of the amount of phosphor and nitrogen discharged into the lake. We did the research step by step to find out the main factors of eutrophication in Poyang Lake.

5. Results of the research

In Poyang Lake, the dominant algae from 2009 to 2014 were green algae (13% of total amount of plankton), cyanobacteria (15% of total amount of plankton) and diatoms (53% of total amount of plankton).

The amount of cyanobacteria has the tendency of increasing, and it has greatly increased during the years. Cyanobacteria's dominance is a sign of eutrophication in Poyang Lake. According to the research, the dominant types of cyanobacteria are anabaena, microcystis, and planktothrix, with the anabaena being the most abundant. The concentration of cyanobacteria is 0.69mg/L in wet seasons, and 0.5mg/L in dry seasons

In 2007 there was already sign of cyanobacterial bloom in certain sections of the Poyang Lake. From 2013 to 2014, the areas affected by cyanobacterial bloom increased dynamically. There have been blooms occurring in the Duchang waters, Junshan Lake, Kangshan lake, and a number of other regions.

表1 鄱阳湖五大水系主要营养盐年均输入浓度 (单位:mg/L)

营养盐	赣江	抚河	信江	饶河	修河
总磷	0.082	0.091	0.126	0.069	0.082
总氮	0.496	0.081	0.587	0.573	0.421
硝酸盐氮	0.150	0.475	0.368	0.165	0.096
亚硝酸盐氮	0.003 1	0.002 8	0.001 9	0.002 1	0.001 2
氨氮	0.187	0.189	0.098	0.429	0.068

The nitrogen contained in Poyang Lake is about 0.99-1.31mg/L, and the phosphor contained in Poyang Lake is about 0.09-0.13mg/L. Both are above the normal standard, especially nitrogen.

In 2014, the total amount of wastewater discharged from local factories is about 172.41 million tons, and contains 170.5 tons of phosphor, 2277,989 tons of nitrogen, as well as 1286.4 tons of ammonia-nitrogen. That's an amount large enough to cause catastrophic damage.

Meanwhile, the use of fertilizers in farms are also producing nitrogen and phosphor that enter the lake.

There are three main types of fertilizers used in China:

Ammonium phosphate: N-P-K (12-60-0)

Diammonium phosphate: N-P-K (21-53-0)

Potassium dihydrogen arsenate: N-P-K (0-24-27)

(N-P-K stands for the ration of nitrogen to phosphor to potassium)

The fertilizers have three levels of concentration, which are:

High concentration: $\geq 40\%$

Medium concentration: $\geq 30\%$

Low concentration: $\geq 25\%$

As we can see, the concentration of nitrogen and phosphor in fertilizers is a tremendous amount.

The paper industries produced the largest amount of waste water (28.9% - 36.74%), and the chemical raw materials and chemical products manufacturing industry comes second.(15.13% - 24.52%)

表 4.5 2014 年总磷排放行业分布表

行业名称	2014 年	
	排放量 (千克)	贡献率 (%)
有色金属矿采选业	178	0.10
非金属矿采选业	10	0.01
农副食品加工业	11859	6.96
食品制造业	76496	44.87
饮料制造业	3871	2.27
纺织业	1403	0.82
纺织服装、鞋、帽制造业	118	0.07
木材加工及木、竹、藤、棕、草制品业	0	0
造纸及纸制品业	794	0.47
石油加工、炼焦及核燃料加工业	246	0.14
化学原料及化学制品制造业	11799	6.92
医药制造业	29571	17.34
化学纤维制造业	1075	0.63
黑色金属冶炼及压延加工业	52	0.03
有色金属冶炼及压延加工业	816	0.48
金属制品业	6	0
通用设备制造业	1603	0.94
交通运输设备制造业	29	0.02
电气机械及器材制造业	30574	17.93
总计	170500	100

The food manufacturing industry is the major source of phosphor discharge, reaching an amount of 76.5 tons (Food debris can contain large quantities of phosphor).

表 4.4 五年中工业氮排放行业分布表

行业名称	2010 年		2011 年		2012 年		2013 年		2014 年	
	排放量 (吨)	贡献率 (%)	排放量 (吨)	贡献率 (%)	排放量 (吨)	贡献率 (%)	排放量 (吨)	贡献率 (%)	排放量 (吨)	贡献率 (%)
煤炭开采和洗选业	1.3	0.05	18	0.78	20.7	0.94	19.6	0.82	39	3.03
有色金属矿采选业	0.7	0.03	0.2	0.01	2.9	0.13	2.9	0.12	2.8	0.22
非金属矿采选业	1.4	0.06	1.2	0.05	0.8	0.04	0.8	0.03	1.6	0.12
农副食品加工业	35.6	1.48	62.7	2.71	67.7	3.07	118	4.91	91.9	7.14
食品制造业	18.7	0.78	13	0.56	12.4	0.56	8.6	0.36	14.8	1.15
酒、饮料和精制茶制造业	62.4	2.60	47.9	2.07	30.4	1.38	37.5	1.56	30.3	2.36
烟草制品业	0.0	0	0	0	0	0	0.2	0.01	0.1	0.01
纺织业	78.6	3.19	69.6	3.01	70.9	3.21	74.7	3.11	70.5	5.48
纺织服装、服饰业	9.1	0.38	11.3	0.49	11.8	0.53	11.9	0.50	12.9	1.00
皮革、毛皮、羽毛及其制品和制鞋业	9.5	0.40	20.3	0.88	20.7	0.94	25.9	1.08	22.9	1.78
木材加工和木竹藤棕草制品业	0.0	0	0	0	0	0	0.6	0.02	0.2	0.02
家具制造业	0.0	0	10.1	0.44	0	0	0	0	0	0
造纸和纸制品业	57.1	2.38	47.4	2.05	58.4	2.64	51.2	2.13	34.7	2.70
印刷和记录媒介复制业	0.1	0	0.1	0	1.1	0.05	2.1	0.09	1.2	0.09
文教、工美、体育和娱乐用品制造业	21.6	0.90	0.2	0.01	0.6	0.03	0.6	0.02	0.9	0.07
石油加工、炼焦和核燃料加工业	87.8	3.66	107.8	4.67	107.8	4.88	158.6	6.60	131.4	10.21
化学原料和化学制品制造业	1605.1	66.92	1491.4	64.55	1400.5	63.42	1355.2	58.38	246.3	19.15
医药制造业	146.8	6.12	128.4	5.56	90.8	4.11	152.4	6.34	139	10.81
化学纤维制造业	198.3	8.27	196.8	8.52	214.5	9.71	214.5	8.92	178.2	13.85
橡胶和塑料制品业	1.0	0.04	2.8	0.12	2.5	0.11	2.4	0.10	4.5	0.35
非金属矿物制品业	1.5	0.06	10.3	0.45	9	0.41	35.4	1.47	81.9	6.37
黑色金属冶炼和压延加工业	41.5	1.73	34.9	1.51	12.9	0.58	19.7	0.82	11.1	0.86
有色金属冶炼和压延加工业	5.3	0.22	9	0.39	8.7	0.39	34.1	1.42	36	2.80
金属制品业	0.9	0.04	0.3	0.01	0.8	0.04	2.6	0.11	2.8	0.22
通用设备制造业	0.3	0.01	0.8	0.03	2	0.09	4.7	0.20	4	0.31
专用设备制造业	0.5	0.02	0	0	1.9	0.09	1.7	0.07	7.3	0.57
汽车制造业	0.0	0	0.5	0.02	9.4	0.43	16.8	0.70	65.2	5.07
铁路、船舶、航空航天和其他运输设备制造业	9.3	0.39	10.4	0.45	27.9	1.26	29.5	1.23	18.4	1.43

Nitrogen discharge reached 2277.989 tons in 2014, which is a large number. The major contributor to such emission is the pharmaceutical industry (29.76%).The chemical raw

materials and chemical products manufacturing industry comes second (18.06%).

The industries that produced the largest amounts of ammonia-nitrogen respectively are chemical materials and chemical products (19.15% – 66.92%), chemical fiber manufacturing (8.27% – 13.85%), petroleum processing and coking & nuclear fuel processing, pharmaceutical manufacturing.

It turns out that Qingshanhu district is the most polluted one so far.

6. Conclusion

There are large amounts of nitrogen and phosphor discharged into the lake every year, which is why the lake is facing eutrophication.

After analyzing the data of waste water discharge, farming fertilizer usage and human activities near Poyang Lake, we concluded that apparently a lot of factors contributed to Poyang Lake's eutrophication.

First, people farm more than they used to do, so they use more fertilizer, eventually discharging more nitrogen and phosphor into the lake.

Second, numerous industries discharge a lot of wastewater that contain nitrogen and phosphor also got into the lake. We can see from the data we collected from the research that the industries' wastewater contains large amounts of nitrogen and phosphor, and is the major factor leading to eutrophication. Certain industries, such as pharmaceutical manufacturing, food manufacturing, chemical materials and chemical products, chemical fiber manufacturing, petroleum processing and coking & nuclear fuel processing, pharmaceutical manufacturing and paper industries, are the main culprits.

Human activities near the lake made the lake harder to flow, and led to the deposition of toxic chemicals, making it harder for the lake to recover on its own.

So we concluded that all these three factors led to the eutrophication effect in Poyang Lake, with industries being the main factor, and agriculture being the second.

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