

# Strengthen Prevention and Control of Phosphorus Pollution in Typical Areas and Improve Water Quality

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Abstract: In recent years, phosphorus pollutant has become the primary pollutant of surface water in the key national lakes, reservoirs and the Yangtze River economic belt. Phosphorus pollution has become the major problem for water pollution prevention and control in some regions, and becomes a major bottleneck affecting water quality improvement in the river basins. According to the notice on strengthening the prevention and control of nitrogen and phosphorus pollution issued by the ministry of ecology and environment in April 2018, the new challenges emerge for the nationwide water pollution prevention and control work: phosphorus pollution is severe in some typical areas, and phosphorus pollution prevention and control will become the work focus in areas where water quality is difficult to improve.

## 1 INTRODUCTION

In China, the areas with phosphorus pollution are mainly located in Minjiang River, Tuojiang River, Wujiang River, Qingshuijiang River, as well as the Yichang and Jingzhou sections of the Yangtze River economic belt since 2011 (Figure 1). In 2017, the average concentration of total phosphorus in Minjiang River was 0.164 mg/L, lower than the limit of type with the water quality standards class III. The average concentrations of total phosphorus in Tuojiang River, Qingshuijiang River and Wujiang River were 0.234 mg/L, 0.214 mg/L and 0.21 mg/L, which was worse than the surface water standard class III. Moreover, due to high total phosphorus concentration in Yichang, Jingzhou sections of Yangtze River, the surface water quality has dropped from class IV to V from 2014 to 2017. Both the 13th five-year plan for ecological and environmental protection and the plan for the ecological and environmental protection of the Yangtze River economic belt clearly identified the Minjiang River, Tuojiang River, Wujiang River, Qingshui River and Yichang section of the Yangtze River as key areas for prevention and control of total phosphorus pollution (Xu et al., 2018). And Guizhou, Sichuan, Hubei, and Yunnan provinces need to pay more attention on controlling the

phosphorus pollution (Wang et al., 2006; Yao et al., 2015).

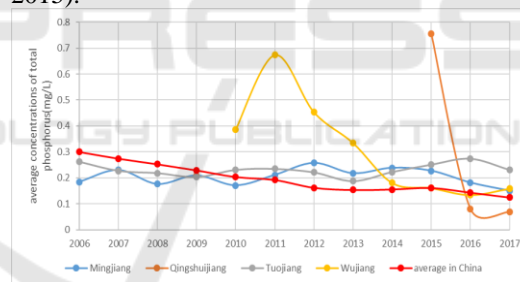


Figure 1: The average concentrations of total phosphorus in main rivers in China.

## 2 METHOD

In total 1940 ranking section (point) of surface waters distributed in 978 rivers and 112 lakes (reservoirs) from 2006 to 2017 were analysed under the Chinese national environmental monitoring Assessment.

Our team surveyed the basins of Minjiang River, Tuojiang River, Wujiang River, Qingshui River and Yichang section of the Yangtze River in 2017. We analysed the data of environmental statistics covering 2006-2017, including the phosphorus emission and pollution in industrial pollution sources, urban life, and agricultural pollution source.

### 3 RESULTS

#### 3.1 Industrial Pollution Sources

Extensive phosphorite mining and loose end-of-pipe treatment lead to phosphorus loss to the environment. In the four provinces of Hubei, Sichuan, Yunnan and Guizhou where phosphorite are concentrated, the majority of ores are either medium or low-grade phosphate deposits. With low-level mining technology and local rainy climatic, the loss of phosphorus in phosphate deposits and mine waste worsen (Cao et al., 2012). In addition, irregular design and the existence of small-medium scale phosphate mines without soil dump also worsen water. For example, in Yiling district of Yichang, Yuan 'an county, Chongqing Wulong, Youyang, Pengshui and Guizhou Guiyang, Zunyi, Tongren, Qiannan and southeast Guizhou, the phosphate mining enterprises have relatively low level mining and mineral processing technology, and the construction of slag field and tailings reservoir are not well standardized.

Phosphorus chemical wastewater treatment is challenging, and phosphorus excessive emissions is particularly serious. The production technology of phosphorus chemical industry is complex, and the waste water treatment is difficult because the amount of sewage is huge as well as the concentrations of phosphorus is large. In the 468 enterprises producing phosphate compound fertilizer in China, 56% of them are located in Guizhou, Sichuan, Hubei and Yunnan provinces. The managements of many enterprises are extensive and are difficult to inspect. Uncontrolled large amount of waste discharge due to production accidents happened from time to time. For instance, in the Leshan section of Minjiang, the Deyang section of Tuojiang, the Wujiang section below the middle reaches of the Wujiang River in Guizhou province and the Qingshui River, the phosphorus pollution severely worse than the standards, mainly due to discharge from phosphorus chemical enterprises, phosphorus gypsum piling, and so on.

Low utilization rate of phosphogypsum restricts the sustainable development of phosphorous chemical industry. In China, the annual discharge of phosphorus gypsum reaches about 75 million tons, and the accumulative heap stock exceeds 300 million tons. However, the comprehensive utilization rate of phosphorus gypsum is only 30% of the annual output. For example, in Guizhou province phosphorus and gypsum cause a waste of

phosphorus resources of more than 100,000 tons per year. The long-term storage of phosphogypsum not only causes serious environmental damage but also causes huge waste of resources, which has become the main bottleneck of the development of phosphorous chemical industry.

#### 3.2 Pollution Sources of Urban Life

The phosphorus emission of urban life is large and the level of governance is low. In 2015, the sewage treatment rates in counties of Sichuan, Guizhou, Yunnan and Hubei provinces were 70.48%, 77.84%, 76.22% and 82.62%, respectively, lower than the national average rate. 63% of the 1433 sewage treatment plants are subject to the "urban sewage treatment plant pollutant discharge standard" (GB18981-2002) level B. Of these, 342 sewage treatment facilities in 600 urban sewage treatment plants in basins of Mintuo River, Wujiang River and Qingshui River have a total phosphorus emission concentration, which is subject to the "pollutant discharge standard of urban sewage treatment plants" (GB18981-2002) level B.

#### 3.3 Agricultural Pollution Source

The treatment level of the pollution from livestock and poultry breeding is low, and the point-source pollution is not effectively controlled. The proportion of large-scale farms in livestock and poultry breeding during the 12th five-year plan period in Sichuan, Guizhou, Yunnan and Hubei was slightly low, at 50.04%, 78.09%, 63.95% and 35.69% respectively. The basic pollution prevention measures of large-scale livestock and poultry farms have not been completed in Zunyi, Tongren, Bijie, Yiling, Yidu, Dangyang, Zhijiang. The utilization of phosphorus resources is insufficient.

The proportion of phosphorus emission in aquaculture is prominent, and fertilizer application rate in planting industry is large. The phosphorus pollution contribution of planting industry and aquaculture industry in Sichuan, Guizhou, Yunnan and Hubei accounts for 18.6% and 22.8% of the phosphorus pollution contribution in China respectively. Among them, the phosphorus emission of aquaculture industry in Hubei accounts for 19.13% of the national proportion, which is a key area for the prevention and control of phosphorus pollution in aquaculture.

## 4 DISCUSSION

Implement phosphorus pollution control and special emission limits of total phosphorus for phosphorous chemical enterprises in the typical areas. Implement phosphorus pollutants reduction replacement for projects of new, modified (expanded) construction enterprises in the controlled areas (Quan et al., 2005). In addition, define the upper limit and intermittent targets of total phosphorus emission for units that discharge pollutants with the permit. Carrying out trials of paid use and trading of pollutant discharge indicators as well as popularizing trade in emission reduction credits for industrial point sources should be well done. It should also establish cross-provincial water quality and ecological environment compensation mechanism and economic responsibility mechanism. Construct phosphorus pollutants discharge funds, to support new phosphorus treatment facilities and pollution related technology and research (Cao et al., 2018).

Strengthen the monitoring and management of pollutant discharge units, build automatic inspection systems in the factories, to realize real-time monitoring, promoting data transmission and early warning of pollutant discharge by key units in the region. One should introduce the environmental tax on phosphorus emissions for phosphorous related products, which will force low cost and high pollution companies to withdraw from the market. As well as reinforce the responsibility of enterprises; strengthen the disclosure of environmental pollution information, promoting environmental credit evaluation, and establishing a red-yellow card system for the emission from industrial enterprises.

## 5 CONCLUSIONS

Strengthen whole-process management of the industrial chain and promote technological innovation and accelerate structural adjustment of key phosphorus emission industries such as phosphorus chemical, starch, textile, agricultural and sideline industries. Carry out special rectification of the phosphorus chemical industry, with the focus on phosphate fertilizer industry. Close down the "three highs and one low" small phosphate chemical enterprises, limit the development of industries such as diammonium, ammonium, heavy calcium, phosphate fertilizer and compound fertilizer made from phosphoric acid, and stop expanding the scale of production of superphosphate and calcium-

magnesium phosphate fertilizer. Improve phosphorus filtration efficiency and phosphorus recovery rate in phosphorous chemical industry and water efficiency in phosphate compound fertilizer enterprises. Carry out the renovation of wet-process phosphoric acid purification, and promote the development of phosphorus product structure toward fine and high-end products, such as food grade standards, electronic grade standards industries. Promote the recovery of phosphoric acid, strengthen the harmless treatment and comprehensive utilization of phosphogypsum, and realize the standardized management of phosphogypsum and phosphorus residue storage (Zhou et al., 2018).

Strengthen the strategic resource management of phosphate mineral resources and establish the strategic reserve mechanism of phosphate mineral resources. One should improve the recovery rate and recycle rate of phosphate mineral resources, and reduce phosphorus loss rate in the process of mining, close small phosphate mines, reduce wasting of phosphate mineral resources, and strengthen the comprehensive utilization of medium and low-grade phosphate mines and associated resources, focusing on Hubei, Yunnan, Sichuan and Guizhou provinces.

Realization the joint urban and rural control of domestic sewage phosphorus removal process. To carry out deep phosphorus removal of sewage treatment plants in typical areas, biological phosphorus removal and chemical phosphorus removal processes shall be carried out, and the phosphorus pollutants emission concentration of sewage treatment plants with a scale of more than 2,000 tons/day shall be less than 0.5mg/L. In typical areas, the rain and sewage diversion pipe network is fully implemented, and the maintenance of existing sewage pipe network is strengthened to reduce phosphorus pollutants leakage. Through the construction of decentralized sewage treatment facilities and access to the nearby urban sewage treatment facilities, the collection and treatment level of rural domestic sewage is improved. Constructed wetland and land usage were adopted to reduce the total phosphorus concentration of tail water in sewage treatment plants. The production and use of phosphorus detergent are prohibited throughout the region, and the management of kitchen sewage and the utilization of garbage and wastes are strengthened, so as to control the phosphorous content of waste water at the pollution source.

Improve the management rate of large-scale farms and utilization rate of fecal waste resources. With Sichuan and Hubei as the focus, it should

continue to strengthen pollution control in large-scale farms and promote the recycling of waste from livestock and poultry breeding. Carry out the dismantling of purse seining and the standardization of cage aquaculture. With Hubei as the focal point, it will be actively promoted for artificial compound feeding and strengthen the management of inputs for aquaculture. Overall implement the formula fertilization based on real-site soil testing, with Sichuan, Hubei and other provinces as the focus, reduce fertilizer application, guide and support the organic fertilizer industry.

Promote the storage of biological phosphorus, reduce the phosphorus pollutants load of the branches in Yangtze River. Restore the vegetation of the bare mountain in phosphorus rich areas such as Hubei, Yunnan, Guizhou and Sichuan provinces, and construct the buffer zones along the lakeside buffer ecological zone and the riverbank buffer zone of dry tributaries in typical areas. The sewage is stored with biological phosphorus through microorganisms, hydrophilic plants and terrestrial plants, prevent phosphorus pollutants from entering the water body.

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