Global Warming Effects on Clean Water Supply in China

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Recent crisis in clean water supply in China

Harmful algal blooms are a serious threat to safe drinking water and recreational use of beaches and lake waters. In particular, the toxins of cyanobacteria (blue-green algae) can lead to human and animal illness and mortality, reduction of fisheries production as well as many environmental and recreational related problems. These will have potential impacts on ecosystem functioning, services and eventually local economic development. Recently, reemergence of widespread algal blooms in Chinese lakes and rivers has deepened the crisis of clean water supply in China and raised a wide public concern. A survey result of monitored rivers and lakes in 2007 indicated more than 50% of rivers and large lakes were heavily polluted (Fu 2008). Last year, the outbreaks of blue-green algae in one of the five largest Chinese lakes, Taihu, covering about a third of the lake surface, caused several million people in Wuxi city to go without access to drinkable water for more than one week. The same problems also happened in other two Chinese Lakes, Chaohu and Dianchi.

Cyanobacterial blooms in Lake Taihu, China

Impact of global warming on harmful algal blooms

There are many factors influencing algal blooms, such as nutrient, light, temperature, wind-driven mixing, water retention time, species competition and predation. Excessive nutrients (e.g., nitrogen and phosphorus), which come from municipal, industrial wastewater, fish farms as well as agricultural activities and atmospheric dry and wet deposition into the water bodies, are mainly to

blame for causing the blooms. However, rising temperatures as a result of global warming seemly have promoted the blooms in different ways. In general, warming can increase nutrient concentrations and enhance cyanobacterial competitive ability. Dry and hot weather removes more water from lake surfaces by evaporation, which thereby increases nutrient concentrations in the water bodies, and higher water temperatures also increase nutrient release from the sediment into water column. As an example enhanced the competitive ability, cyanobacteria can thrive better and compete better for nutrients than other phytoplankton at higher temperatures. Elevated temperatures also create suitable mixing and stratified conditions for cyanobacteria to suppress other phytoplankton (Paeri & Huisman 2008). Climate change may be an important contributor to the recent algal blooms in Chinese lakes. For example, the recent monitored data indicated that the average of water temperature in winter in Lake Taihu in the 2007 increased about 2.53 ^{0}C compared with 1994, and water depths decreased about 0.12m in comparison of previous years (1998-2006), while the point and non-point nutrient loadings did not have significant change during the period of the algal outbreaks.

How do we meet the new challenges?

Over last 10 years, the Chinese government has made great efforts to prevent and control water pollution through: 1). Amending and improving a series of laws and regulations relative to water pollution prevention; 2). Identifying and prioritizing three rivers (Huai River, Liao River and Hai River) and three lakes (Lake Taihu, Lake DianChi and Lake Caohu) for pollution prevention in sustainable use of water resources; 3). Limiting and closing products and factories with heavy pollution; and 4). High investment in infrastructure for improving and expanding wastewater treatment and sewerage systems and in restoration engineering projects (UNEP, 2004). In the long term, these efforts will eventually achieve required water quality standards. However, ecosystem restoration is a long process. Given the high nutrient levels in the water bodies (e.g., the averages of total nutrient N and P in Lake Taihu in 2006 were over 4 mg N /l and 0.1 mgP/l, respectively), the lakes may take many years to come back to oligotrophic (clearwater) status. Therefore, tackling more efficiently the current crisis in clean water supply caused by algal blooms should be based on experience and a strategy that combines short- and long-term plans to ensure that the adverse impact can be minimized. Long-term prevention, control and mitigation policies need to be implemented strictly for emission reduction of greenhouse gases and nutrients as well as other pollutants. Previous successful experiences may help in prevention and mitigation of the bloom impact such as: 1). Building early-monitoring and warning systems that can forecast the blooms events in several days; 2). Early mechanical and hand removal of algae before they form large blooms and spread widely; 3). Inducing water to change water retention time before the wide blooms take place; 4). Partly dredging sediment in very polluted areas to reduce amount of nutrients available and remove from the sediments; and 5). Limiting and shutting down heavy pollution industrials.

Trade-offs between economic costs and environmental benefits

Climate change is beginning to harm human health as well as the economy. If the Green GDP measure is considered, subtracting pollution costs from traditional GDP in China would have resulted in 3.1 percent lower growth. Growth in some of the provinces would even have been reduced to zero (Assadourian, 2008). The trade-offs between economic costs and environmental benefits should be considered in sustainable use of water resources. Limiting motorized traffic and temporally closing businesses with heavy pollution during the Beijing Olympics provided evidence that blue skies can be achieved. The same strategy may also be applied in improving water quality driven by global warming and anthropogenic activities.

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