Role of rural solid waste management in non-point source pollution control of Dianchi Lake catchments, China

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Abstract In recent years, with control of the main municipal and industrial point pollution sources and implementation of cleaning for some inner pollution sources in the water body, the discharge of point source pollution decreased gradually, while non-point source pollution has become increasingly distressing in Dianchi Lake catchments. As one of the major targets in non-point source pollution control, an integrated solid waste controlling strategy combined with a technological solution and management system was proposed and implemented based on the waste disposal situation and characteristics of rural solid waste in the demonstration area. As the key technology in rural solid waste treatment, both centralized plant-scale composting and a dispersed farmer-operated waste treating system showed promise in rendering timely benefits in efficiency, large handling capacity, high quality of the end product, as well as good economic return. Problems encountered during multi-substrates co-composting such as pathogens, high moisture content, asynchronism in the decomposition of different substrates, and low quality of the end product can all be tackled. 92.5% of solid waste was collected in the demonstration area, while the treating and recycling ratio reached 87.9%, which prevented 32.2 t nitrogen and 3.9 t phosphorus per year from entering the water body of Dianchi Lake after implementation of the project.

Keywords co-composting, Dianchi Lake catchments, non-point source pollution, rural solid waste

1 Introduction

Dianchi Lake - the most famous plateau lake in China - is located in the center of Yunnan province, China. Dianchi catchments measure a total of 2920 km² with 5.70×10⁸ m³ runoff [1]. During the last half-century, nitric and phosphoric pollutants had accumulated because of the discharge of industrial wastewater and sewage from the riverside, which degraded the eco-system at Dianchi catchments. The increasing deterioration of the water quality and heavy pollution of eutrophication in Dianchi Lake caused frequent blue algae outbreaks. This has been detrimental to the development of the industry/agriculture and the health of residents around the area. As one of the “three lakes” project for environmental pollution control, the issue of eutrophication and pollution treatment of Dianchi Lake had attracted the attention of various groups.

In recent years, with control of the main municipal and industrial point pollution sources and implementation of cleaning of some inner pollution sources, the discharge of point source pollution decreased gradually, while non-point pollution has become increasingly distressing (Fig. 1). The non-point pollution sources in this area include soil erosion, pollutants from the water body of the lake, release of nitrogen/phosphorous from farmland, pollutants from the countryside and towns, and surface runoff. The survey on the pollution sources of Dianchi catchments showed that 14155 t of total nitrogen (TN) was produced, of which 10940 t was discharged to the water body; total phosphorous (TP) were 1486 t and 1320 t, respectively [2–4]. The amount of TN and TP released from non-point pollution sources was 2955 t/a and 417 t/a, respectively, which took up 27% and 45% of TN and TP discharged to the water body of the lake. Therefore, controlling non-point source pollution is the key step to mitigating pollution and controlling eutrophication of the water body of Dianchi Lake.

Among various types of non-point source pollution, the pollution source from agricultural activities is the main cause of the deterioration and pollution of Dianchi Lake. The demonstration area of this research is located at Chenggong County, Kunming City, which is one of the important agricultural bases in this area and thus has become one of the major pollution sources...
due to intensive agricultural activities, a dense population, and rapid economical development. The pollution source includes rural solid waste, domestic sewage, soil erosion from the plateau, and nitrogen/phosphorous loss from the field (flower and vegetable plantation) in the dam area (Fig. 2). The output path and quantity of pollutants showed that rural solid waste accounted for a dominating part of non-point source pollution, which included plantation solid waste, dejecta, and domestic garbage (Annual Report of Environmental Monitoring in Kunming City, 2002). These solid wastes had the characteristics of seasonal fluctuation in volume of production, scattered distribution, and the lack of a collection and transportation system. They were flushed into the lake through surface runoff in a solid state or leachate during the rainy season when there were frequent rainstorms and became the major pollution source for Dianchi Lake. Therefore, viable and highly effective technology and management measures for rural solid waste treatment are the key path to mitigate pollution of the water body of Dianchi Lake and prevent water quality from getting worse.

According to the literatures, the main protective measures of non-point source pollution included elimination of municipal/industrial raw wastewater discharges, erosion control practices, reforestation and a ban on livestock grazing near catchments, construction of wetland and vegetated buffer zones, and improved nutrient management and reduction of fertilizer application quantities [5–8]. However, most of the researches focus on the technology of mitigation of non-point source (NPS) pollutants in the water or storm-water runoff. The contribution of source control of solid pollutants on water quality has not been discussed sufficiently.

The paper discusses the role of solid waste management in non-point source pollution control and its contribution to pollution alleviation of Dianchi Lake through the analysis of a pollution load and controlling method, the feasibility of non-point source pollution control technology and strategy of solid waste management as well as their effects.