NON-POINT SOURCES OF POLLUTION

Yuhei Inamori
Executive researcher, National Institute for Environmental Studies, Tsukuba, Japan

Naoshi Fujimoto
Assistant Professor, Faculty of Applied Bioscience, Tokyo University of Agriculture, Tokyo, Japan

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Summary

Non-point source pollution loads are loads with their discharge sources spread over wide areas. The precise locations of non-point source loads cannot be identified as they are dispersed throughout the catchment area. It is generally difficult to regulate non-point sources because their discharge locations cannot be clarified. Forms of land use that cause non-point source loads include farmland, forests and urban areas.

The non-point source loads as a percentage of the total load in Lake Kasumigaura in Japan are 44% for organic matter (COD), 42% for nitrogen, and 23% for phosphorus.

Approximately 30% of fertilizer used in arable land becomes non-point source pollution. In paddy fields, discharge of water containing mud and fertilizer is the main pollution source.

Livestock excrement affects water quality of river and groundwater as non-point source where livestock are at pasture, breeding density is high and management of excrement is unsatisfactory.

When there is an increase of paved area, there is an increase of rainwater discharge to water bodies because penetration of rainwater to the ground is inhibited. Pollutants accumulated in urban area are washed out by rainfall and flow into water bodies.

In agriculture, slow release fertilizers coated with material to control the elution of nutrients is used as a countermeasure against non-point source pollution. Moreover, modified fertilization methods which fertilize around the rice seeding and control the diffusion of fertilizer into the water, are becoming more popular.

To control discharge from urban areas, ditches and residential land should be cleaned with the cooperation of residents through information and educational programs—reducing the quantity of pollutants discharged by rainwater. Control of surface flow by flood storage basins, and permeable pavements to facilitate infiltration, are useful measures to reduce pollution from urban areas.

It is important to retain areas of forest for conservation of water bodies as they absorb nutrients and other pollutants.

1. Introduction

Non-point source pollution loads are loads with their sources dispersed over wide areas. These loads flow into water bodies including rivers, lakes, reservoirs, ponds, wetlands, groundwater, and the sea, and they may contain organic matter, nitrogen, phosphorus, and agricultural chemicals, causing pollution and eutrophication. Rainfall, discharge from agricultural fields, cleared forest and urban runoff are typical non-point sources. Measures to effectively deal with these sources are extremely important because the contribution of non-point source to total pollution is increasing as a result of improved wastewater treatment facilities. In this chapter, a definition is given for non-point source pollution; amounts of non-point source loads are given and countermeasures for non-point source pollution are described.

2. Definition of a Non-point Source

Non-point source loads are those whose discharge sources are dispersed over wide areas: the discharge of fertilizer and agricultural chemicals from agricultural land, rainfall containing atmospheric pollutants, exhaust gases, discharge of sediment accumulated on roofs, roads, and the ground surface, animal excreta, carcases of dead animals, fallen leaves in urban area, and discharge of pollutants from clear-felled parts of forests. The amount of precipitation is closely related to non-point source pollution loads because rainwater conveys pollutants to water bodies.

The precise locations of non-point source loads cannot be identified as they are scattered throughout the catchment area. Non-point sources flow through channels, storm sewers and groundwater and eventually into rivers, lakes, reservoirs and the ocean. It is generally difficult to regulate them because their discharge locations cannot be clarified. They may contain organic matter, nitrogen, phosphorus and agricultural chemicals. Non-point sources cause eutrophication and disruption of ecological balance. Measures to effectively deal with these sources are therefore extremely important.

The rise in the concentration of agricultural chemicals in river waters when agricultural chemicals are spread on fields is regarded as non-point source pollution. Forests play a role in purifying rainfall because the nitrogen and phosphorus concentrations in surface

water draining from forests are lower than those of the rainfall. If the forest is cleared, soil and organic matter are washed out by rainfall leading to organic pollution and eutrophication. Even in forest without human activity, organic matter, nitrogen and phosphorus loads in the drainage water may be high in autumn and winter, as the dead plant material decomposes. In spring and summer, however, the nutrients are absorbed by the growing vegetation.

It is generally not possible to take localized measures to deal effectively with non-point source pollution loads because they exist over wide areas. More precise inventories reveal that in many regions their contribution to total pollution is higher than had been previously estimated.

The non-point source loads as a percentage of the total load in Lake Kasumigaura in Japan are 44% for organic matter (COD), 42% for nitrogen, and 23% for phosphorus (see Figure 1 in *Point Sources of Pollution*). As it is important to clarify the source and quantity of inflowing pollutants in order to establish water pollution prevention measures, the load per unit of area has been calculated for each non-point source load: organic matter, nitrogen, and phosphorus (see Table 1). A comparison of pollutant loads from paddy fields, arable land, forests, golf courses and cities, shows that the load from cities is relatively high. It is, therefore, predicted that the urbanization of a catchment area increases its non-point source loads.

Pollutant	Paddy field	Arable fields	Mountains and forests	Golf course	Rain	Urban runoff
COD	7.19	2.45	3.83	3.83	6.95	15.3
Nitrogen	2.4	2.34	1.56	1.56	3.08	2.4
Phosphorus	0.095	0.116	0.054	0.054	0.13	0.18

unit: kg・km^{-2}・day^{-1}, averaged over 1 year.

Table 1. Amount of pollution source used for estimation of non-point source pollution of Lake Kasumigaura

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Bibliography

Foundation of River and Watershed Environment Management (2005). Kasen to eiyouenrui. (In Japanese), 179 p., Gihodoshuppan, Tokyo.

Inamori, Y., Fujimoto, N. and Kong, H.N. (1997). Recent aspect and future trend of countermeasures for renovation of nitrate-contaminated groundwater. (In Japanese). Journal of Water and Waste, vol.39, 936-944.

Inoue, T. (2003). Pollutant Load Factor from Non-point Source: Present State and Task for the Future. (In

Japanese). Journal of Japan Society on Water Environment, vol. 26, 131-134.

Kunimatsu, T. and Sudo, M. (1997). Measurement and Evaluation of Nutrient Runoff Loads from Mountainous Forested Lands. (In Japanese). Journal of Japan Society on Water Environment, vol. 20, 810-815.

Sudo, R. and Onuma, K. (2000). Water Quality of Lake Kasumigaura and its Non-Point-Source Pollutants. (In Japanese). *Environmental Conservation Engineering*, vol. 29, pp. 509-515.

Takeda, I. (1997). Non-point Source Pollutants in Agricultural Lands. (In Japanese). Journal of Japan Society on Water Environment, vol. 20, 816-820.

Biographical Sketches

Yuhei Inamori is an executive researcher at the National Institute for Environmental Studies (NIES), where he has been in his present post since 1990. He received B.S. and M.S. degrees from Kagoshima University, Kagoshima Japan, in 1971 and 1973 respectively. He received a PhD degree from Tohoku University, Miyagi, Japan in 1979.

From 1973 to 1979, he was a researcher for Meidensha Corp. From 1980 to 1984, he was a researcher for NIES, and from 1985 to 1990, a senior researcher for NIES. His fields of specification are microbiology, biotechnology and ecological engineering. His current research interests include restoration of aquatic environments using bioengineering and eco-engineering applicable to developing countries. He received an Award of Excellent Paper, from Japan Sewage Works Association in 1987, an Award of Excellent Publication from the Journal "MIZU" in 1991, and an Award of Excellent Paper, from the Japanese Society of Water Treatment Biology in 1998.

Naoshi Fujimoto is Assistant Professor of Tokyo University of Agriculture, where he has been at his present post since 2000. He received B.E. and M.E. degrees from Tohoku University, Miyagi, Japan, in 1991 and 1993 respectively. He received a D.E. degree in civil engineering from Tohoku University in 1996. From 1996 to 1999, he was a research associate of Tokyo University of Agriculture. His specialized field is environmental engineering. His current research interests include control of cyanobacteria and its toxins in lakes and reservoirs.