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INVESTIGATION OF PHOSPHATE (PO_4^{-3}) AND AMMONIA-NITROGEN (NH_3-N) CONCENTRATIONS AT SOME SELECTED LOCATIONS OF THE MALNICHARA CHANNEL AND THE SURMA RIVER

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ABSTRACT

Sylhet city of Bangladesh is suffering from lack of structured sewerage and drainage system as well as from solid waste mismanagement. The Malnichara channel is responsible for surface runoff conveyance from its urban catchment to the receiving Surma River. In this study, an effort was made to investigate the status of concentrations of phosphate (PO_4^{-3}) and ammonia-nitrogen (NH_3-N) at four locations viz. entrance point of Malnichara to the city, off taking point of Malnichara to Surma River, upstream and downstream point of Surma River to the off taking point. Data was collected from March-April and August–September 2005. Concentrations were measured using UV Spectrophotometer. The phosphate concentration was found to be within the permissible limits set by the Department of Environment (DoE) for fishing, irrigation and recreational purposes. However, ammonia-nitrogen was exceeding the limits.

Keywords: phosphate, ammonia-nitrogen, malnichara channel, surma river.

INTRODUCTION

Storm runoff generated from catchments in an urban area transports pollutants. These pollutants are routed along with the runoff to the drainage system, and eventually to the receiving water bodies. Pollutant loads in storm runoff depend largely on the waste disposal and management in the catchment areas. Types and quantities of pollutants vary widely and are affected by several factors including land cover characteristics, development activities in the catchment and the source of pollutants (Khan *et al*, 1998). The pollutant concentrations in storm runoff are also significantly affected by rainfall characteristics and the antecedent conditions of the catchments.

Quality of living and the water environment in Sylhet city are closely related. Like other parts of Bangladesh, Sylhet city used to have numerous Channels (locally called Chara), ponds and depressions. Most of these Channels, ponds and depressions have been filled up to accommodate the rapidly increasing population (Chowdhury, 2005). As a result, the natural drainage of the city is going to be disrupted. With the rapid increase of population in Sylhet city, the pollutant loads are also likely to increase in future.

In this study, two water quality indicators namely phosphate (PO_4^{-3}) and ammonia-nitrogen (NH_3-N) have been investigated on some selected locations of the Malnichara channel and the Surma River in Sylhet city of Bangladesh. Malnichara channel is one of the nine natural drainage channels passing over the city responsible for conveying storm water discharge. The channel is originated from the Malnichara tea garden and falls on the Surma River at Topoban Residential Area. The River Surma flows over the city and divide the city into two portions namely North and South Surma. The city is famous for its biological resources, tourism and religious belief.

MATERIALS AND METHODS

Selection of water quality parameters:

Commonly, the pollutant load of urban storm water may be expressed in terms of settleable and suspended solids, biochemical oxygen demand (BOD), chemical oxygen demand (COD), total coliform bacteria, nitrate, phosphates and heavy metals (Khan *et al*, 1998). These pollutants have different sources and may cause various environmental and human lives impacts (Peavy *et al*, 1985). In order to carry out an investigation of the quality of Malnichara and Surma River water, two water quality parameters were selected for analysis. These were: (1) phosphate (PO_4^{-3}) and (2) ammonia-nitrogen (NH_3-N). Samples were collected during March – April, and in August - September 2005.

Sampling location:

Water samples were collected from four locations in order to understand the impact of urban catchment on Malnichara channel and on the receiving water body (Surma River). These selected locations were:

- Malnichara channel, at the entrance point to city – the point is located at Choukidekhi.
- Malnichara channel, at the off take point to Surma River – the point is located at Topoban.
- Surma River, upstream of Malnichara at the off take point and
- Surma River, downstream of Malnichara at the off take point.

Sampling locations are shown in Figure-1. Picture of off take point of Malnichara to Surma River is shown as Figure-2.

Figure-1. Sampling locations (A, B, C, D).

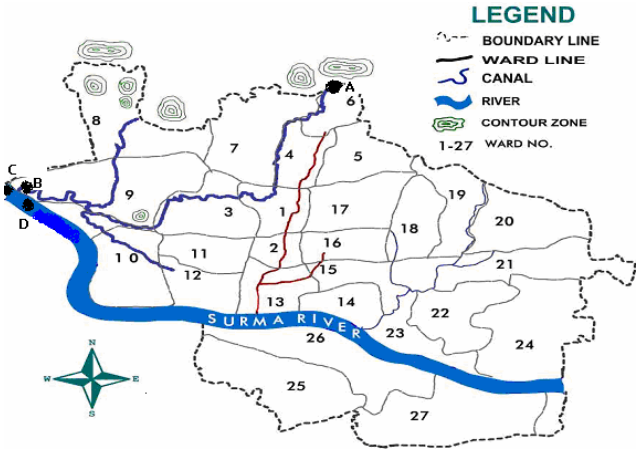


Figure-2. Off take point of Malnichara channel to Surma River.

RESULTS

Data Analysis:

Water samples collected from four different locations were analyzed to determine chemical properties. Phosphate (PO_4^{-3}) and ammonia – nitrogen (NH_3-N) were measured using UV Spectrophotometer.

Phosphate:

For recreational, fishing and irrigation purposes, DoE (1991) environmental quality standards are 6 mg/l, 10 mg/l and 10 mg/l, respectively. In all four locations, phosphate (PO_4^{-3}) concentration does not exceed the standard. However, from Choukidekhi to Topoban, concentration increased in Malnichara channel. In the Surma River, concentration of phosphate also increased from upstream to downstream of Malnichara off take.

Ammonia-nitrogen:

DoE (1991) standards of ammonia nitrogen for various purposes are drinking water (0.5 mg/l), recreational water (2 mg/l) and fishing water (0.075 mg/l). Concentration of ammonia nitrogen in Malnichara channel is tremendously increased from Choukidekhi to Topoban in both dry and after rainfall conditions. At the downstream of Malnichara off take, concentration of NH_3-N in Surma River is increased. Concentration of NH_3-N in Malnichara channel and Surma River exceeds DoE standard for fishing and recreational purposes at Topoban and downstream of Malnichara off take, respectively. Variations of phosphate and ammonia-nitrogen are shown in Figure-3 (a, b, c, d, e).

Figure-3 (a, b, c, d, e). Variations of phosphate and ammonia-nitrogen.

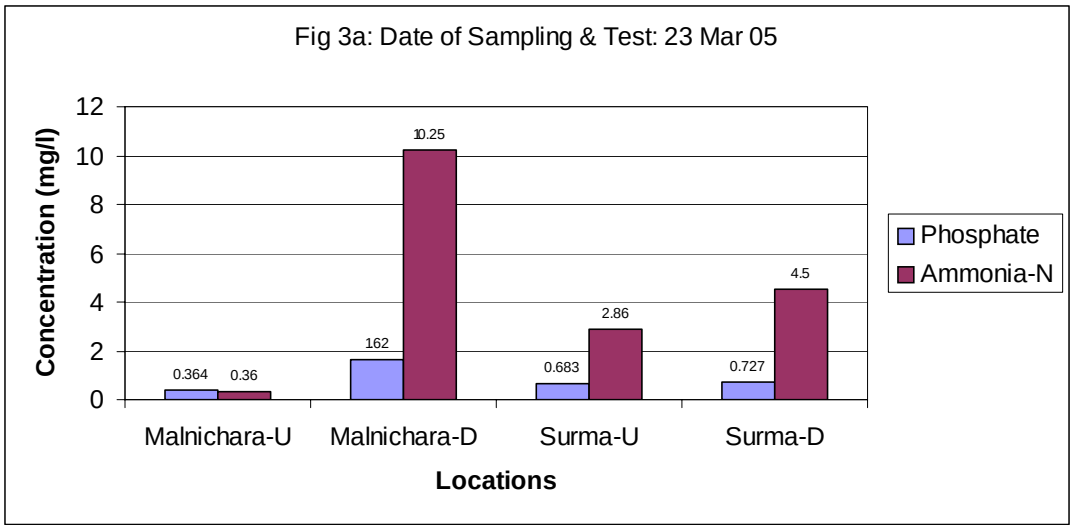


Fig 3b: Date of Sampling & Test: 30 Mar 05

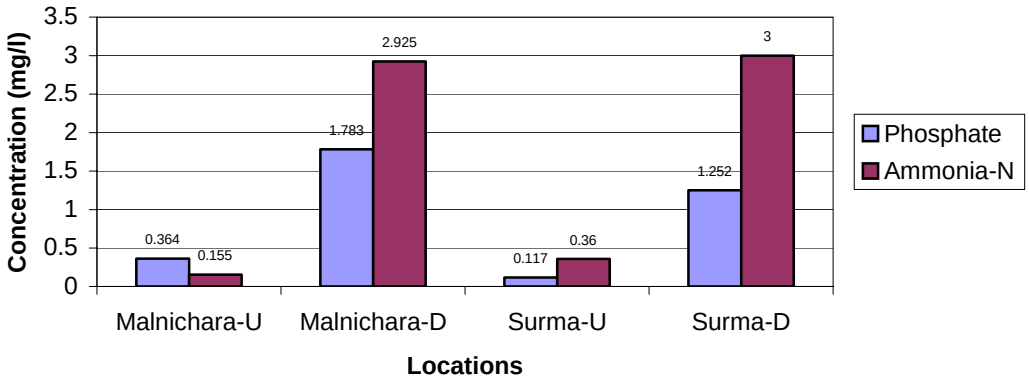


Fig 3c: Date of Sampling & Test: 12 Apr 05

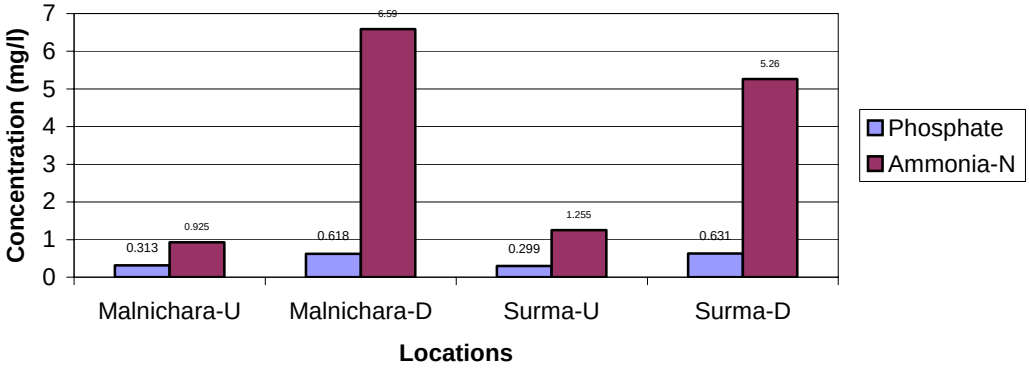
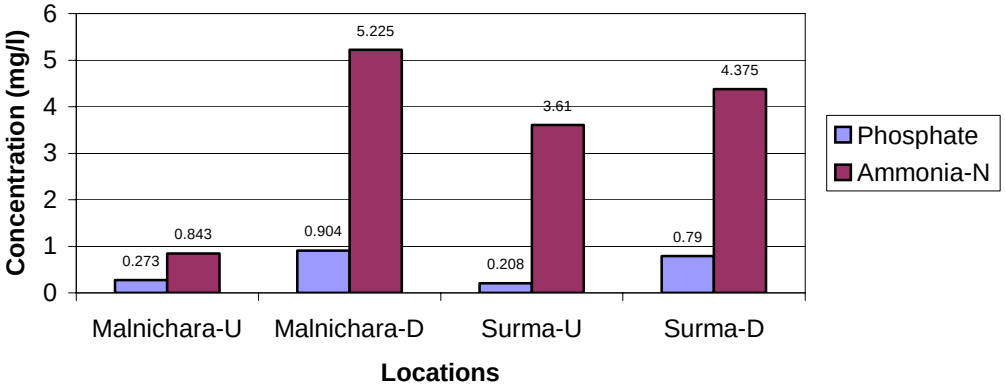
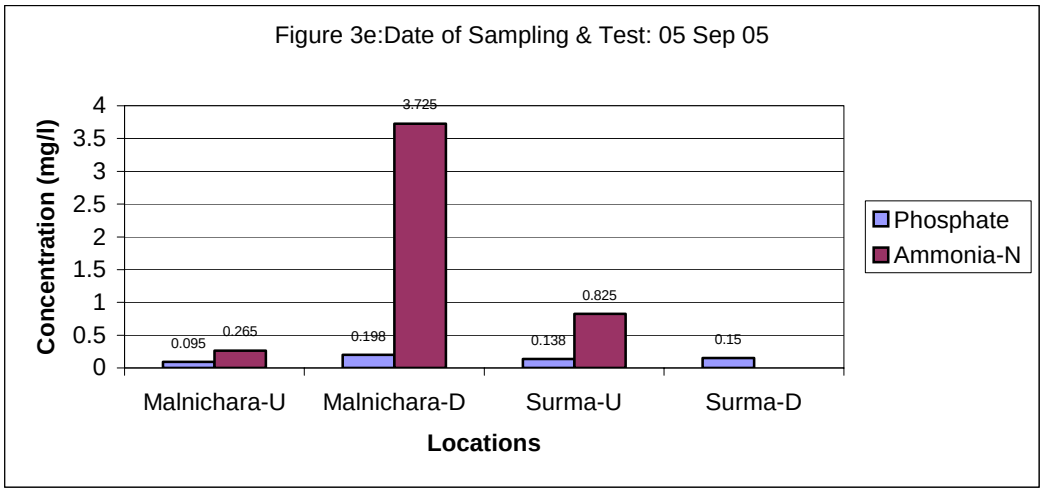


Fig 3d: Date of Sampling & Test: 31 Aug 05





Sources of pollutants:

As there is no structural sewerage system in Sylhet city, household's gray water and storm water are conveyed by roadside drains to natural channels and ultimately falls to the Surma River. It has been observed that in low income residential and slum area, domestic sewage is directly conveyed by these Channels. Malnichara channel, which is originated from Malnichara Tea Garden, enter the city at Choukidekhi, passes through Badambagicha, Housing Estate, Jalalabad R/A, Sagar Dighir Par, Kanishail and finally falls to the Surma River at Topoban R/A. During field survey, following sources of pollutants were identified:

Domestic sewage:

Low income households and slum areas developed along the Malnichara channel at Badambagicha, Jalalabad, Kanishail and Kalibari (Kalibari Khal) has been observed to directly discharge sewage to Malnichara. Non point sources of overland flow are also responsible for sewage pollution of Malnichara.

Solid waste:

At present, a total of 180-200 tons of solid waste is generated in the Sylhet city and only 140 – 160 tons are collected (Chowdhury, 2005). Uncollected waste is washed out to the roadside drains and natural canals. Blockage of drains by solid waste reduces the carrying capacity of drains and natural canals and also a source of pollution. Figure-4 is a picture of drain blocked by solid waste.

Figure-4. Drain blocked by solid waste at Pathantula.

Garbage extracted from drain:

Sylhet City Corporation has very limited resources to clean the drains. A fixed labour has been assigned for each ward to clean the drains. Drains are cleaned at an interval of 8 – 10 days. During cleaning, garbage is stored beside the drain and it has been reported by local people that stored garbage are not collected regularly. As a result, during rainfall garbage are washed out to the drains again. Figure-5 (a, b) shows the pictures of stored garbage beside the drain.

Figure-5a. Garbage stored along the street during cleaning (Subid Bazar).

Figure-5b. Garbage stored along the street for a long time (Londoni Road).

CONCLUSION AND RECOMMENDATION

Concentration of Phosphate and ammonia-nitrogen have been found to be increased in Malnichara channel from Choukidekhi to Topoban, concentrations in Surma River have also been found to increase from downstream to upstream of Malnichara off take point. Water quality investigation indicates that water of Malnichara channel is polluting from various sources like sewage and garbage disposal.

Sylhet is a newly established City Corporation. Infra-structural facilities like sewerage system; piped water supply system and drainage system is not present here. Recently, in many portion of the city, unplanned concrete box culvert has been constructed on the natural channels by the city corporation authority. Detailed study on integrated approach of drainage management of Sylhet is required prior to implement any intervention on natural channels. A separate sewer system with sewage treatment facilities is required for maintaining storm runoff quality.

Storm runoff generated from the catchment areas carry significant amount of pollutants. The level of pollution in the storm water and in the receiving water bodies is generally a matter of concern. Water quality analysis of samples collected from drainage channels during different rainfall events will have to be performed in order to identify the urbanization impact on storm water runoff quality. Runoff discharge of all natural channels will have to be measured so that pollutograph can be drawn.

REFERENCES

Chowdhury, R. K. 2005. Planning for Integrated Storm Water Drainage Management of the Lower Part of Malnichara in Sylhet City. M.Sc.(WRD) Thesis. Institute of Water and Flood Management, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh.

DoE. 1991. Environmental Quality Standards for Bangladesh. Department of Environment, Ministry of

Environment and Forest, Government of the Peoples Republic of Bangladesh.

Khan, M. S. A., Chowdhury, J. U. 1998. Dhaka City Storm Water Quality Assessment, Technical Report No.1. Institute of Flood Control and Drainage Research, BUET, Dhaka-1000.

Peavy, H. S., Rowe, D. R., Tchobanoglous, G. 1985. Environmental Engineering. International Edition, McGraw- Hill Book Company, New York.