Summary Assessment
Baseline Water Quality Survey for Rajshahi, Bangladesh

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Introduction

This summary is one in a series of summaries written by the Wastewater Agriculture and Sanitation for Poverty Alleviation in Asia (WASPA Asia) project. The WASPA Asia project aims to develop and test solutions for sanitation and wastewater management, to reduce the risks form wastewater use in agriculture. The approach involves the development of stakeholder coalitions at town and national level, called Learning Alliances, which will bring together the main stakeholders into a participatory process through which actions will be planned and implemented.

The WASPA Asia project is funded primarily under the EU Asia Pro Eco II Programme of the European Commission. It is being undertaken in Sri Lanka and Bangladesh by the International Water Management Institute (IWMI) and COSI in Sri Lanka; the International Water and Sanitation Centre in the Netherlands; NGO Forum for Drinking Water Supply and Sanitation in Bangladesh; and the Stockholm Environment Institute (SEI) in Sweden.

Conclusions and Recommendations

The purpose of this study was to know more about the quality of wastewater in the city drains and the suitability of that water for irrigation.

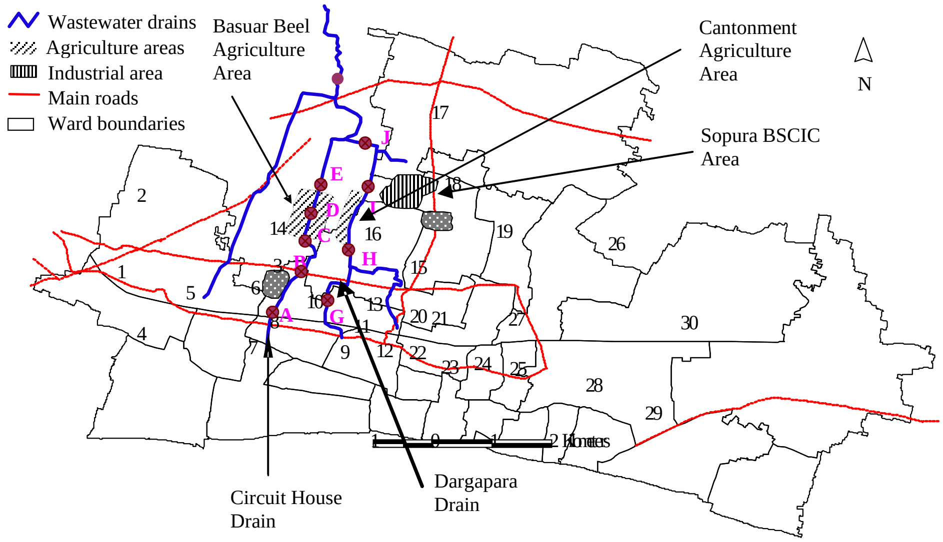
It can be concluded that the major problem in using wastewater in agriculture in the project area is the high level of faecal contamination, which presents a potential health risk. The number of Nematode eggs detected were also found to exceed the World Health Organisation (WHO) guidelines for wastewater irrigation (2006).

The analyses also showed that Basuar Beel is also contaminated. This is not surprising as it receives water from the drains but it may be of concern because it is used for domestic purposes such as bathing and washig household items, it may also pose a health risk to some residents of Bashuar Village. Therefore, management strategies and treatment methodologies are needed to bring down the levels of coliform.

In relation to treatment options it is interesting to note that the 5-day biochemical oxygen demand (BOD_5), total nitrogen, ammonia, orthophosphate and total phosphate levels appear to be lower at the outflow form the *beel* than the inflow. This may be due to natural processes or dilution. However, Basuar Beel has no effect on the Faecal Coliform levels.

Main Findings

A number of storm water drains flow from the south of Rajshahi through the city to the north, either terminating in *beels* or in the Barani River, some 15 km away. The storm water drains also act as the city sewerage systems and carry large volumes of wastewater, although this is not their intended function. A proportion of this wastewater, flowing in Dargapara Drain and Circuit House Drain, is being used for irrigation purposes by urban farmers in the periphery of Rajshahi City. Water samples were taken from 9



points along two drains leading the project area and from 2 deep tube wells. Test results were compared to the Guidelines of the WHO, and Food and Agricultural Organisation (FAO) and the national standards for irrigation water.

This section reviews the water quality results that do not conform to these standards, and which may present health risks and have impacts on crop productivity.

Nitrogen

Nitrogen is a necessary primary macronutrient for plants that stimulates plant growth. It may be added as a fertilizer but can also be found in wastewater as nitrate, ammonia, organic nitrogen or nitrite. If excess nitrogen is applied to a crop it can result in over-stimulation and excessive growth which attracts pests, delays maturity or reduces crop quality. The concentration of nitrogen required varies according to the crop and growth stage.

In general the nitrogen concentrations in all locations were fairly high. The concentrations of both total nitrogen and ammonia were higher in Dargapara Drain where they exceeded 30 mg l^{-1} and peaked at a total nitrogen concentration of over 50 mg l^{-1} at point H where Dargapara Drain enters the Cantonment agricultural area.

The reported ammonia concentrations in the ground water samples were 1.15 mg l^{-1} and 1.90 mg l^{-1} which means that they are above the natural level in ground water of 0.2 mg l^{-1} (WHO 2003). They also exceed the drinking water standards in Bangladesh of 0.5 mg l^{-1} and one well exceeds the WHO guideline of 1.5 mg l^{-1}. Ammonia in drinking water is not of immediate health relevance but it could cause odour problems at concentrations above 1.5 mg l^{-1}. The total nitrogen concentration of the ground water is above the Bangladesh Standard for Drinking Water Quality of 1 mg l^{-1}, at 2 mg $l^{-1}$and 3.2 mg l^{-1}.

Phosphorous

The concentrations of phosphorous were found to be within the acceptable range.

Sodium Absorption Ratio

The relative proportion of sodium to other cations is determined by the sodium adsorption ratio (SAR). This ratio is important because calcium and sodium have different effects on the soil: calcium will flocculate (hold together), while sodium disperses (pushes apart) soil particles. This dispersed soil will readily crust and have water infiltration and permeability problems.

Samples taken from two locations showed values that would require severe restictions on the use of this water for irrigatin purposes, whilst other locations called for moderate restrictions. In the long run, this could have a detrimental impact on the soil structure and quality.

Iron

The iron concentrations in the ground water samples were much higher than the Bangladesh Drinking Water Standard and WHO standards. At these levels there may be a risk of iron being stored in the body (WHO 2003).

Heavy metals

The WHO recommended maximum concentration of chromium (Cr) for crop production is 0.1mg l^{-1} (WHO 2006). This is exceeded in one sampling location, just after the industrial wastewater drain discharges into the Dargapara Drain, indicating that the Cr could originate from the industrial area. Therefore, it is recommended that the soil and the plant material in the cantonment drain agricultural area are tested for Cr to identify any contamination.

The nickel, copper and mercury levels are below the recommended maximum concentration of WHO for crop production (WHO 2006). The arsenic levels in the wells were close to the permissible limits for drinking water but did not exceed them.

The ground water samples exceeded the WHO and national standards for drinking water for chromium, cadmium and lead. This could be of concern but further tests are required before judgements can be made.

Dissolved oxygen, biochemical oxygen demand, and chemical oxygen demand

The most widely used parameter to measure water quality and used in the design of effluent treatment plants is BOD_5, which was found to be in the range 22-112mg l^{-1}. According to WHO (2006) municipal wastewater with a BOD_5 concentration in the range of 110-400 mg l^{-1} can increase crop productivity and condition the soil if it is used for irrigation.

The chemical oxygen demand (COD) values in the samples tested ranged from 83 to 241mg l^{-1} and the COD to BOD ratio was between 2:1 and 4:1, which is characteristic of urban wastewater.

Microbiological characteristics

The biological characteristics of water and wastewater are of fundamental importance to human health. Untreated wastewater that includes faecal waste contains a variety of excreted organisms including pathogens at very high concentrations. The most common indicator organisms used when monitoring water quality are Coliforms and Faecal Coliforms (Metcalf and Eddy 2003).

The original guidelines set by WHO for wastewater used in agriculture had a maximum faecal coliform count of less than 1000 FCU per 100 ml for crops likely to be eaten raw (Pescod 1992). The high level of total and faecal coliform in all tested drain water samples does not comply with the WHO guidelines for use of wastewater in agriculture.

Therefore, it is likely that the farmers are exposed to high levels of excreted organisms as are the people downstream of Bashuar Beel who use this water for other purposes, such as jute processing and washing kitchen utensils and clothes, as they are in primary contact with the wastewater. The water does not satisfy WHO (2006) Guideline for Safe Recreational Water Environments (WHO 2006). It is likely that it is not only the farmers but also the residents around Basuar Beel who are exposed to high levels of excreted organisms.

Nematode eggs

Parasitic protozoa, hook worms, round worms and cestodes were found in the samples, indicating feacal contamination. The fluke eggs could be of animal origin, as they are not reported from humans in Bangladesh. Some of the round worm and cestode species could also be of animal origin.

Implications for WASPA

The water quality testing has some important implications for WASPA that need to be shared with the Learning Alliance members and fed into the Participatory Action Plans.

The most important implications are:

- Use of waste water poses a health risk to the farmers as well as to the consumers.
- Microbial contamination is the main concern, suggesting that interventions to reduce the quantity of domestic waste entering the drainage channels could be beneficial.
- Since microbial contamination is the main problem, on-farm practices and post-harvest activities (such as washing vegetables) could reduce the risk for farmers and their families, and consumers of the produce.
- The use of waste water for irrigation has positive impacts for short term productivity but may have negative consequences in the long term.
- Heavy metal concentrations do not appear to be high which is important for agricultural productivity and consumers. However, the water from the tubewells contain high levels lead and some other heavy metals and should be investigated further.
- There is the possibility that natural treatment processes are taking place along the system; further investigation should establish this and if it is proven to be the case could offer an opportunity to improve the water quality.

References

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