PRESENT STATUS OF WASTEWATER UTILIZATION IN BANGLADESH: A CASE STUDY IN MYMENSINGH PERIURBAN AREA

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Abstract

This study was carried out during the period from January'2005 to November'2005 at Mymensingh Periurban area and selected for field data collection as because the whole wastewater of Mymensingh Municipal area is passed through this Periurban area and this place is very near to Bangladesh Agricultural University.
Wastewater discharge through these three channels were recorded for eleventh months. The dimensions of the wastewater carrying channels were measured at different distances and the mean discharges through the channels were estimated. Wastewater characteristics were also recorded by appropriate methods and instruments. The wastewater characteristics such as pH, EC, TDS, NH_4 and PO_4 were determined. Besides, the plants growing in the channel sides using wastewater were also recorded and analyzed for NH_4 & PO_4.
PRA (Participatory rural appraisal) was also conducted in the Periurban areas to know advantages and disadvantages of using wastewater. Yield data on paddy was collected from the growers. Farmers were interested to use wastewater for irrigation provided they are pretreated by biological or other means.

Key words: wastewater, periurban area, evapotranspiration, participatory rural appraisal and irrigation

INTRODUCTION

Clean water is essential for all living things. To protect the surface water from pollution the effective treatment and management of wastewater is a must. In many developing countries wastewater is the only source of water for irrigation during drought periods. Besides, wastewater is high in nutrient content and requires less chemical fertilizers for crop cultivation.
Wastewater is the flow of used water from a community. The characteristics of the wastewater discharges vary from location to location depending upon the population density and industrial sector working in the area, land use pattern, groundwater levels, and degree of separation between storm water and sanitary wastes. Absolute purification of wastewater is not always possible. But some type of plants can be considered to grow instead of valued crops whose nutrient uptake is very high. These plants will also simultaneously supply firewood for domestic use and biomass for alternate energy production for the rural poor.
The main objectives of this study are to verify the status of wastewater utilization in Mymensingh Periurban areas. The specific objectives are:

1. Measurement of wastewater flow in the channel
2. Measurement of wastewater parameters at field level.
3. Wastewater utilization for irrigation.
4. Influence of wastewater use in crop cultivation

MATERIALS AND METHODS

The volume of wastewater flowing through the channel was measured by knowing the cross sectional area of the channel and the velocity of wastewater flowing through the channel. Irrigation demand was calculated from the following equation: *Irrigation demand (cm/month) = evapotranspiration (cm/month) – rainfall (cm/month)*. Wastewater parameters such as pH, EC, TDS, NH_4, PO_4 etc. were measured in the field by using standard equipment and kits. The yield data was calculated from the farmers during PRA survey.

Sources of wastewater in Mymensingh municipality
Table 1 shows the sources of wastewater in Mymensingh periurban area

Tab. 1. : Wastewater availability from different sources in percent

Source of wastewater	In percent
Household	44
Market	10
Toilets	19
Educational Intuitions	8
Offices	9
Small factories/industries	10

RESULTS AND DISCUSSION

Wastewater discharge
Wastewater is passing through the outlet, contains solid wastes and the sides of the channel is covered with grass, weeds, small plants etc (Fig.2). which restricted the actual flow of wastewater. The colour of wastewater is black and sometimes deep violet. Similar phenomenon was obtained in other channels also. Farmer directly uses this wastewater in their fields. The channel is covered with waterhyacinth, grasses and other small plants that purify the wastewater during the passage in the channel. Minimum discharge was measured in the month of February and the maximum discharge was recorded in the month of August (Fig.3). The discharged varied throughout the year. Flow of wastewater was influenced by intensive use of water,

rainfall, cleanliness of the channel, obstruction caused by solid particles, etc.

Demand of wastewater irrigation

Fig. 4 has described the drought period from January to March and November to December in every year. At that time underground water also declined and farmers have no alternative but to use alternate sources of water for irrigation. As the wastewater is available during that time, this water can be used for irrigation. Fig. 4 was constructed from the evaporation data and rainfall data during the investigation period. From mid march to November, there is abundant supply of water which demands for drainage. Normally this period is called flooding period. All lands were inundated and underwater.

Wastewater parameters

Table 2. shows the wastewater parameters and level of different parameters present in wastewater. This amount determines how much fertilizer is to be applied by the farmers in their crop field while using wastewater.

Utilization of wastewater

Expansion of urban populations, increased coverage of domestic water supply and sewerage are the main causes of greater quantities of municipal wastewater. With the current emphasis on environmental health and water pollution issues, there is an increasing awareness of the need to dispose of these wastewaters safely and beneficially. Use of wastewater in agriculture could be an important consideration when its disposal is being planned in periurban areas. Fig. 5 shows that wastewater is being pumped out into the paddy field and foam is being formed due to the presence of fat or oil combined with alkali solution in the water. Farmer has no other choice but to use this water. Further research is needed to quantify the amount of fat or oil present in wastewater.

Safety precaution

Safety precaution is always necessary to run any system efficiently. In case of operating wastewater plant the following safety measures need to be maintained.

- Preventive maintenance: Problems identified during inspections must be recorded and assessed for necessary maintenance or repair actions (specially channel sides, blockage, overflow etc).
- Provision of quick replacement of any parts
- Vaccination against diseases
- Emergency bypass of excess water from rainstorm to prevent crops from flood
- Spraying in the drain for controlling mosquitoes
- Necessary preventive measure may be taken by farmers during ww irrigation in the crop field.

Reduction of pollutants in wastewater

Floating macrophyte species, with their large root systems, are very efficient at nutrient uptaking. In tropical regions, water hyacinth doubles in mass about every 6 days and a macrophyte pond can produce more than 250 kg/ha d (dry weight). Nitrogen and phosphorus reductions up to 80% and 50% have been achieved respectively. Water hyacinth acts as brushing of suspended solids in the water and cleans it (Fig.6). When wastewater passes through the channel covered with waterhyacinth, grass, crop fields is purified and intensity of pollution reduced. Water Lily has an extensive root system with rapid growth rates. It is an ideal plant for water treatment systems in warm climates. Duckweed (Lemma spp.) has a good capacity for nutrient absorption. Pennywort (Hydrocotyl spp.) has a very good capacity for nutrient uptake. Water hyacinth has a brushing capacity to separate dirt particles from water and its leave possesses high nutrient. The leaves of the aquatic plants contain high nutrient (nitrogen and phosphorous) and they may be used as fertilizer at a later time.

Crop yields

Wastewater increases soil fertility in the field. Survey carried out among 100 farmers in the periurban areas of Mymensingh municipal area. Data collected on the basis of farmer's opinion about the yield condition in the different location surrounding by the channel. The yield was low as because the soil was acidic. The conditions of the fields are shown in Fig. 7a and fig. 7b. Some farmers in this area also use underground water as irrigation purpose and some farmers use wastewater for cultivating paddy.

Growth of the paddy plant is seen very healthy having more leaves and plants but production is not sufficient (Fig. b). Soil becomes more fertile and acidic which help decreasing production of paddy. Even in some areas farmers use chemical fertilizer with the hope that yield will increase. But production was still not satisfactory due to over growth of the plants. Paddy yield at different location is shown in Table 3.

The highest average EC, TDS and NH_4 values are 1226 µs/cm, 0.56 ppt and 130 mg/l at Maskanda exit and corresponding lower average values are 737 µs/cm, 0.35ppt and 16 mg/l respectively at 2 km distance from the exit point. The average EC, TDS and NH_4 values are 850 µs/cm, 0.47ppt and 80 mg/l at 1 km distance from Maskanda exit. In the Maskanda exit point pH value is low 4.12 but at a distance 2km from the Maskanda exit point pH value was high 5.1. pH values increased as the horizontal distance increased due to absorption of organic acid by waterhyacinth, Duck weeds, grass grown in the channel or by crops grown in the farmers field and also by sedimentation and natural phenomena. Yield had a close relation with pH and other salt content and yield increased with lowering the volume of pH, EC, TDS and NH_4 respectively.

Effect of wastewater on Soil

Survey carried out in different locations of the surrounding Mymensingh periurban area. The author questioned farmers, farm labors and observed the following results: 88% farmers said wastewater increase soil contamination by sedimentation of sludge, nutrients etc. on soil, 94% told wastewater is good for crop production because less chemical fertilizer

is required, water available throughout the year etc., 93% told that wastewater added fertilizer, 91% told wastewater increase acidity which causes low yield and only 2% told that wastewater could not be useable for production of rice or crops etc and may be suitable for non crop fast growing trees.

Nutrient uptake

The nutrient uptake rates of different crops are shown in table 4. On the basis of uptake rates, one can decide the application rate of fertilizers in their crop field. Wastewater application will reduce the fertilizer requirement.

Water requirement for crops

The water requirements for different crops are shown in table 5. Water requirement for Boro rice is very much higher than the other traditional crops in Bangladesh.

CONCLUSION

- Sustainable wastewater is available in the periurban areas of Mymensingh municipal area.
- Land up to 400 acre can be made available for establishing wastewater treatment plants for treated water supply (equivalent to river water).
- Farmer can use wastewater as irrigation water for crop production.
- Natural purification of wastewater by water hyacinth is possible
- Preventive measure is necessary for working in the wastewater.
- Higher yield is possible where pH value is high.
- Wastewater after biological treatment can be used as irrigation water to field crops and also in non-fruit fast growing plants for producing firewood
- Wastewater should be released in open places like rivers, canals or ponds after necessary treatments

ACKNOWLEDGMENT

Acknowledgment also due to farmers, Department of public health engineering, Department of environment, Chairman municipalities for providing information and help during the course of the study.

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Received for publication on April, 26,2006
Accepted for publication on April 16,2007

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Fig. 2. : Wastewater outlet at Maskanda

Fig. 3. : Wastewater discharge through the three outlets of Mymensingh Municipal area

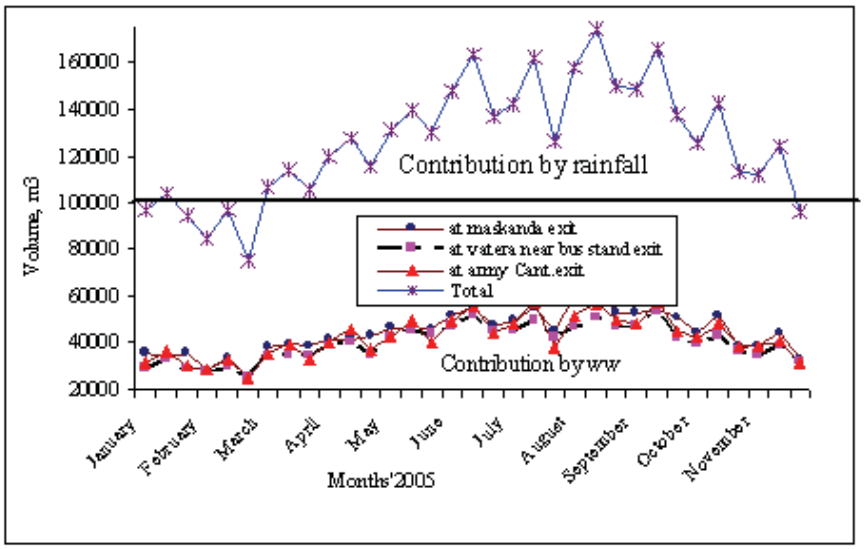

Fig. 4. : Irrigation demand

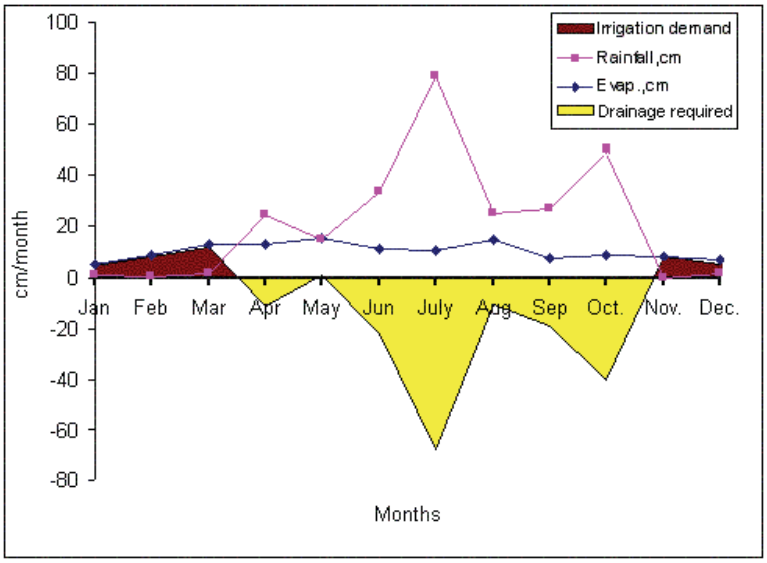

Fig. 5. : Wastewater used for cultivating paddy

Fig. 6. : Wastewater passing through channel covered with waterhyacinth

a) b)

Fig. 7. : Paddy growth using underground water (a) and using wastewater (b).

Tab. 2. : Wastewater parameters at different areas in Mymensingh Municipal area

Location		pH	EC, µs/cm	TDS, ppt	NH4, mg/l	PO4, mg/l
1	Mean	4.5018	1099.4545	0.4545	70	57.2727
	STD	0.67425	139.80658	0.10473	52.38977	57.19335
	STD error	0.11737	24.33720	0.01823	9.11989	9.95608
	CV(%)	14.97722	12.71599	23.04159	74.84252	99.86141
2	Mean	4.6539	989.8788	0.4482	20.9091	111.6364
	STD	0.88583	31.75075	0.07630	24.17173	88.41939
	STD error	0.15420	5.52710	0.01328	4.20776	15.39184
	CV(%)	19.03397	3.207539	17.0242	115.6039	79.20304
3	Mean	6.2100	609.3636	0.1489	0.0	0.0
	STD	0.37332	12.62146	0.01931	0.0	0.0
	STD error	0.06499	2.19711	0.00336	0.0	0.0
	CV(%)	6.011614	2.071252	12.96492	-	-
4	Mean	5.3975	704.0909	0.3000	7.4545	85.5455
	STD	0.62156	28.56392	0.05274	6.70397	27.30052
	STD error	0.10820	4.97234	0.00918	1.16701	4.75241
	CV(%)	11.51561	4.056852	17.57919	89.93127	31.91346

1-Maskanda, 2-Vatera, 3 –Beltoli, 4- Chorar Beel

Tab. 3. : Paddy yield at different areas

Location	Distance, km	Ph	EC, µs/cm	TDS, ppt	NH4, mg/l	*Yield, kg/acre
Maskanda to Chorar Beel	0	4.12	1226	0.56	130	1153.85
	0.5	4.34	1000	0.53	100	1184.62
	1	4.67	850	0.47	80	1307.69
	1.5	4.85	800	0.4	50	1415.38
	2	5.1	737	0.35	16	1538.46

*estimated based on survey among the farmers, farm labours

Tab. 4. : Nutrient uptake rates for selected crops, kg/ha.year

Crops/trees	Nitrogen	Phosphorus	Potassium
Corn	175-200	20-30	110
Cotton	75-110	15	40
Potatoes	230	20	245-325
Soybeansa	250	10-20	30-55
Wheat	160	15	20-45
Rice	139	88	211
Grapes	66	26	74
Grass	250-350	20-50	225-315

a.Legumes will also take nitrogen from the atmosphere.
– not available

Tab. 5.: Crop water requirements

Crop	Water requirements (mm/season)
Boro Rice	1000
Wheat	350
Potatoes	350
Groundnut	350
Sunflower	350
Soybean	300
Mustard	300
Sweet Potato	200
Lentil or Chick pea	150

Source: BBS, 1995