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URBAN LIQUID WASTE MANAGEMENT: A CASE STUDY FROM DHANBAD NAGAR NIGAM

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ABSTRACT

Waste Water released from houses and industries is the major harmful anthropogenic contamination in surface and sub surface water in urban agglomeration. It is well known fact that the elevated level of nitrate in water is due to waste water. Untreated waste water takes the form of runoff and ultimate causing pollution in pond or reservoir constructed at downstream. This runoff also percolated downward in porous soil media during course of lateral and down slope flowing before reaching to higher order river.

In the Present study, a Micro watershed in which Baramuri urban agglomeration resides, has been selected in order to investigate the potentiality of contamination of surface and sub surface water by waste water using Remote sensing, G I S and Resistivity imaging Techniques.

Thematic maps have been generated using satellite image to point out various potential indicators. All these data have been processed using ARC GIS software. The present investigation reveals that study area is drained by two natural drainlet. These drainlet are carrier of waste water discharge as well as rainwater in term of runoff. Natural forms of these drainlets are being destroyed by encroachment through construction of new settlement on them and are activated to receive the waste water. These drainlets are about to taking perennial form due to regular discharge of waste water.

This area is also highly porous due to presence of thick weathered material as top layer. Electrical Resistivity Image of this area indicates about thick mantle of weathered material varying in thickness from 20 meter to 30 meter.

Water table in this weathered zone lies about to 2m to 4m below ground. Groundwater is easily being recharge from discharge of waste water due its shallow occurrence .Waste water in form of runoff is also accumulated in a pond near polytechnic.

Construction of water filter unit at appropriate location on drainlets has been suggested in the paper.

Keywords- waste water, Urban, Remote sensing etc.

I. INTRODUCTION

The urbanization has increased from 27.81% in 2001 Census to 31.16% in 2011 in [1]. In developing countries, the ever increasing human population and the associated anthropogenic activities have accelerated the phenomenon of urbanization in the past decade. In India, the rate of increase of urban population shot from 11% in 1901 to about 31.16% in 2011. The rapid growth rates of the cities, combined with their huge population base, has left many Indian cities lacking in basic infrastructure services like water supply, sanitation and sewerage, and solid waste management. [2] Waste generation is the major side effect of urbanization. Wastes are resulted in form solid, liquid and gas. Solid and liquid wastes cover same areas on the ground. Waste in form of gas directly goes in air. Solid and liquid waste is the major source for contamination of water in urban area. Gaseous from of waste many also resulted from degradation and decomposition of solid waste. The sources of liquid waste are the discharge of waste water from houses and industries.

II. Objectives

Following are major objectives.

1. Identification of routes of waste water in urban area.
2. Assessment of vertical and later percolation of waste water during over land runs off.
3. Assessment of runoff of waste water and contamination of surface water bodies.
4. Formulation of action plan for reducing waste water accumulation in pond located at downstream

III. The Study Area

The study area falls in between 23d 47m 24s to 23d 50m 35.73 s N latitude and 86d 23m 45.34 to 86d26m40.14s E latitude. The study site is a part of Dhamodar watershed having area of about 16 square kilometer. Role of watershed in management of wastewater is very important as its movement is guided by surface topography. Therefore a mini watershed from the northwest of Dhanbad town has been selected for present investigation to know the transformation of natural drainage into waste water carrying drainage. Present

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study is the spatial investigation of a watershed turning into waste waster shed due to urbanization A watershed is a geographic area delineated by land features. Stakeholders whose activities are on water or land within a watershed should be involved in defining problems, setting priorities, and implementing solutions [3]. The Dhanbad town enjoys a hot summer and cold winter. The temperature range from 8 ^{0} C in December to 45 ^{0} C in May. The average annual rainfall is 1295.0 mm, most of which is precipitated during the monsoon months. Monsoon arrives in Dhanbad in the third week of month of June and end in the month of September.

IV. Material and Methodology

Open source satellite image has been used for generation of various thematic map i. e. drainage map, geological, geomorphic and land use / land cover map in order to depict the surface and sub surface set up of area under investigation.

Satellite image has been enlarging up to 1: 1000 scales to identity smallest features. Micro water shed boundary has been demarcated using the height file attached in Google earth. Road passing through the village and arrangement of drain has been considered the indicator for micro water boundary demarcation.

Electrical Resistivity imaging techniques has been employed to scan the sub-surface set up, particular to know the thickness of weathered material and water table. Electrical resistivity survey was carried out at various sites in the study area, employing Schlumberger profiling techniques for creation of Electrical Resistivity Image (ERI).

A D.C resistivity meter (SSR- MP-AT) was used to measure the apparent resistivity. This instrument has been fabricated by M/s integrated Geo-instrument and service private limited, Hyderabad. It measures the apparent resistivity directly in ohm – meter. In the presence of random (non-coherent) earth noise, the signal to noise ratio can be enhance by $\sqrt{N}$, where N is the number of stacked reading. SSR-MP-AT is a microprocessor based signal stacking resistivity meter in which running average of measurement [1,(1+2)/2,(1+2+3)/3.(1+2+3…+16)/16] up to the chosen stacks are displayed and the final average is stored automatically in memory. It has resolution of $10^{-5.}$ The SSR MP-AT contains mainly two parts viz. current unit and microprocessor based measuring unit built in single housing. The current unit sends bipolar signals into ground at a frequency of about 0.5 Hz. The receiver has 4.5 digital dual slope analog to digital converter unit which can measure the ground potential and current with resolution up to10 µV and10 µA respectively. The microprocessor controls the current unit, determines attenuation level for potential measurements, computes the resistance values, average the measured values, keeps the data in memory display and transfer the data to PC.

A switch box was used as an intermediate connecting device between resistivity meter and electrodes. All electrodes have been coded by a specific number and connected with same code number key of switch box. Apparent resistivity was converted into absolute resistivity of various layers using inverse slope software i.e. based on inverse slope principle proposed by Sankaranarayan and Ramanujachary (1967). Resistivity with thickness and depth of each layer has been also determined by using this software. Horizontal extension (i.e. surface distance,), vertical extension (i.e. depth) and resistivity of layers were placed in A, B, C column respectively in the worksheet of surfer software for generation of image. Thereafter, all the data were transferred in data modules for griding, which is important step before contouring. Finally, 2D image has been generated in form of coloured contour interval and pixel format (figure-3and4). 2D Electrical Resistivity Image of study area has been also generated using Voxler software by combining all VES data of various stations at image line

Denudational hill is composed of quartz reef which is the more resistance to weathering in relative other lihtounits in study area. Therefore it possesses relative high topography. These Quartz reef have been emplaced in a fault. The direction of orientation of quarz reef is NW to SE. There are two parallel quartz reef have been traced out. The general slope of study area is towards south. The quarter reef acts as barrier to drainage and allow to flow along its flanks. The drainages have the cross the reef where they are fractured. These quarter reef have been emplaced from great depth to the surface in present form. Movement and occurrence of surface and ground water have also been influenced by this natural wall like barrier. Fractured quartzite gneiss and schist have been noticed with weathered material on the top . Quarter reef is younger in age in comparison to other litho units. The lithological control on drainage has caused retention of groundwater. It has been noticed that 10 to 20 m thick weathered product present on the top of schist and quartzite and gneiss.

V. Result and Discussion

Waste water flows from upland to law land. This discharge water flows in a drainage as run off. Movement of waste water is mainly controlled by watershed configuration and watershed elements i. e drainage pattern, lithology, geomorphology and land use / land cover.

Details of drainage parameter are given in table below.

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Table 1: Morphology of Drainage

Name of Order	Frequency	Total length
1st	26	13061 m
2nd	4	8270 m
3rd	2	1186 m
4th	1	942 m

The drainage changes its order from 1st to 4th order in study area. It reveals that huge amount of water in form of runoff has shaped the present catchment. This natural drainage has been turned into waste water drain due to rapid urbanization in its catchment area (figure 1).

Alignment or orientation reflects that all drainage is controlled by lithology and structure in the study area (figure2). Straight course of river has been noticed in its various order, might be happened due to presence of long and narrow denudational hill. Upland and lowland pediplain are the common landforms. Topographic expression of upland pediplain has been formed due to presence of quartz reef that are resistive to weathering agents(figure3). Low land pediplain has been formed by removal of top weathered material by drainage. Land use pattern of study area reveals that upland is the first choice for settlement. Most of main road have been constructed in mid upland. Low land pediplain has been also used for construction due to unavailability of vacant land in upland (figure 4). Drainage has been turned into waste water drain in dense urban agglomerate. Natural flowing of this drainage has been disturbed at many localities due to dense and close construction of houses. Downstream flow of waste water has been reduced due to chocking of drains in dense populated areas. The natural drainage has been turned into perennial nala in the dense populated area due to discharge of waste water from residential complexes and industrial area. Electrical resistivity imaging has been carried out along a line in between Khatal and Baramuri settlement. This image is the evidence of thick weathered material comprises of top layer in the study area (figure 5)

An action plan map has been suggested by considering the lithological, geomorphological , structural and land use / cover as controlling factors to minimize waste water discharge by construction of filter plant at suggested locations (figure 6). These locations are the junction points of first order drainage and crossing point of quarts reef. Large water treatment plant is suggested where drainage have crossed the quarter reef. All the first order drainage may be lined to reduce the in situ percolation.

VI. Conclusion

Recharging of Groundwater through waste water along Nala has to be minimized by making it concrete lined. Filter unites as suggested at appropriate location may help to reduce contamination in downstream water bodies. Dumping of solid waste in nala must be banned. Filling of Nala with solid waste must be discouraged by regularly monitoring using satellite image.

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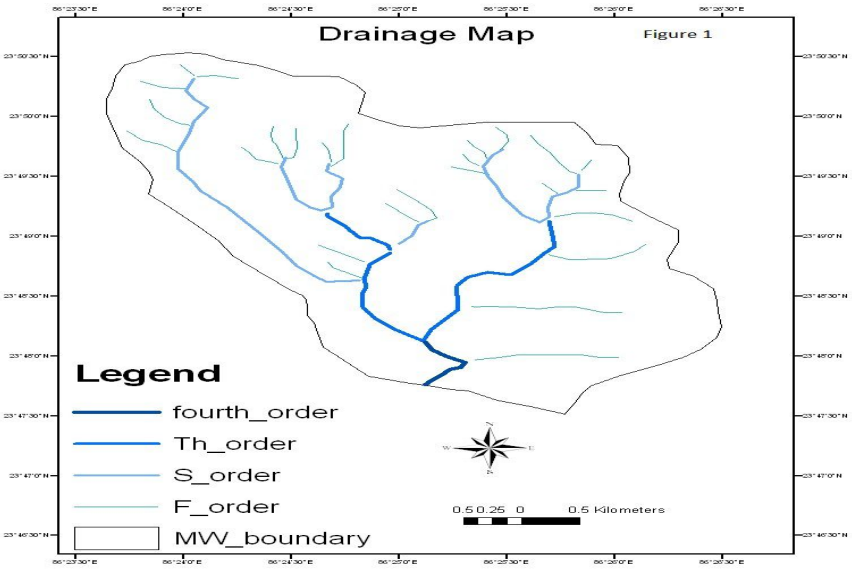

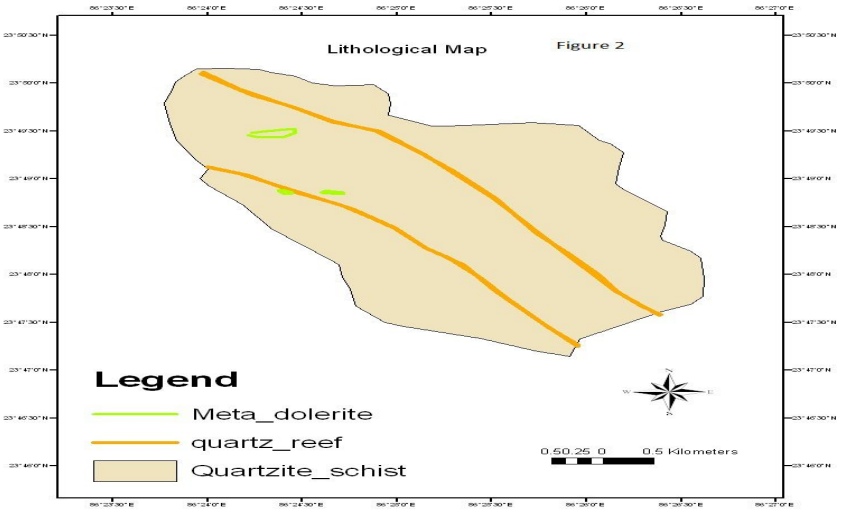

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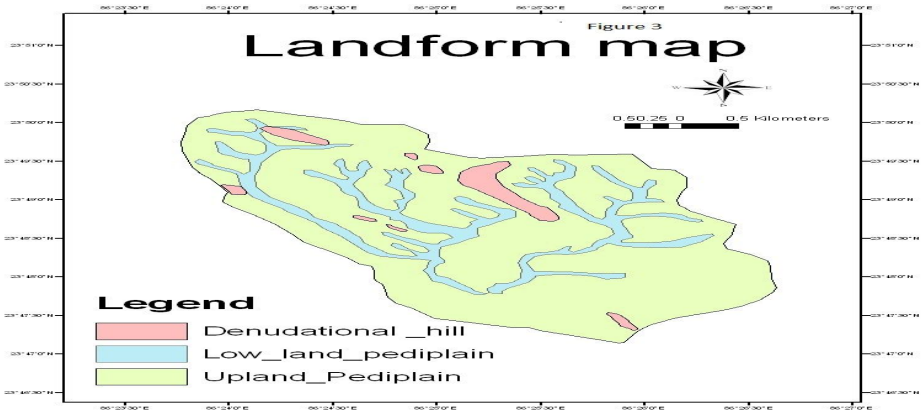

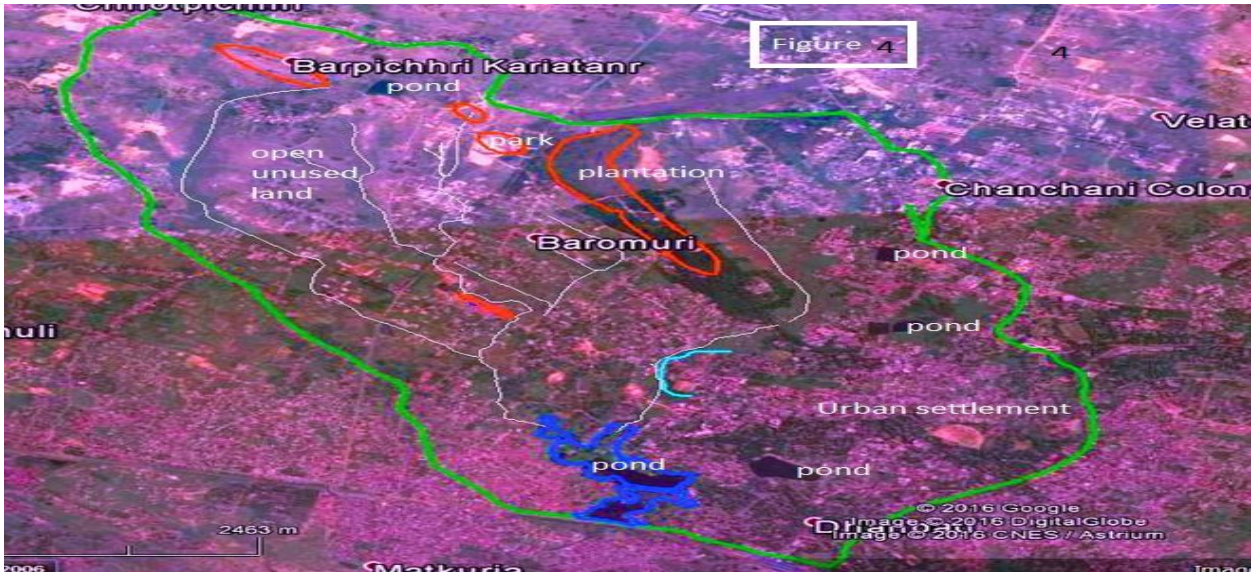

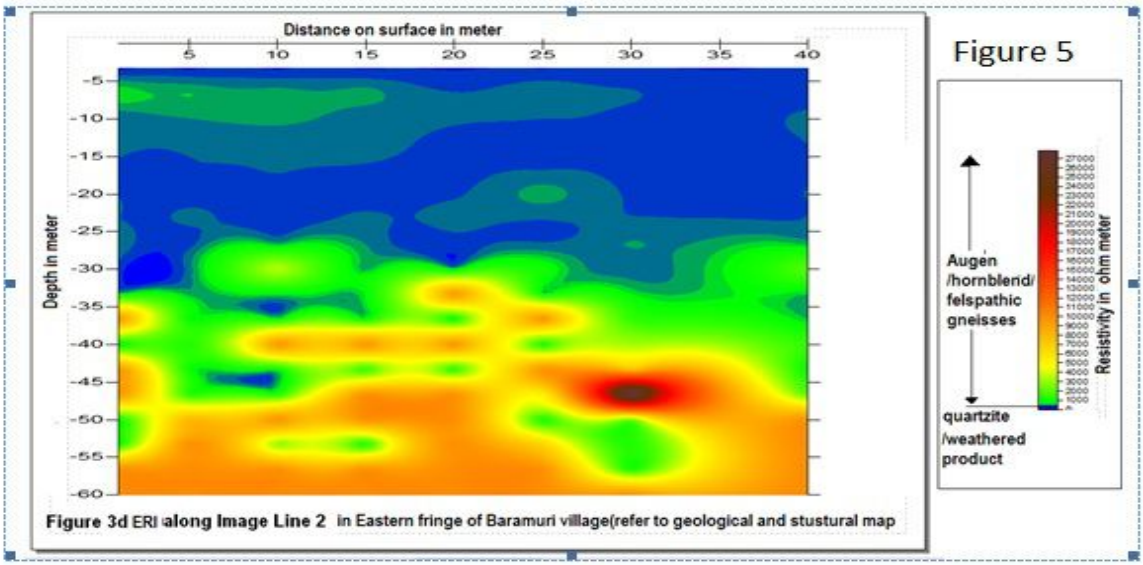

Figure 3d ERI along Image Line 2 in Eastern fringe of Baramuri village(refer to geological and stustural map

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