Analysis of Physicochemical Parameters of Soil from Patalganga River, (Maharashtra, India)

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Abstract: ***Many rivers in India are facing threats of water and soil pollution, majorly those flowing along industrial belts. Patalganga river is an important river in Maharashtra supplying water to 40 villages in Raigad district. Many industries are situated on the left bank of the river and often the tail water of power projects, domestic sewage water, industrial effluents (untreated or partially treated) often find their way into the river. Percolation of pollutants present in the water affect the soil quality of the river bed which primarily provides nutrients to aquatic plants. In the present investigation, monthly soil samples from seven different sites were collected from January 2019 to June 2019, along the Patalganga river belt and studied for Physico - chemical parameters - temperature, pH, texture, moisture content, organic content, bulk density and water holding capacity using standard methods. The results showed fluctuating levels of some parameters which may be attributed to impact of the pollutant load along with seasonal variation.***

Keywords: Patalganga river, Soil Pollution, Physico - chemical parameters

1. Introduction

An organisms surrounding is characterised by the environment which includes biotic factors such as the availability of prey, competitors, predators and parasites and abiotic factors like temperature, pH of the water and soil in which an organism lives. Soil provides the baseline for the organisms habitat and contributes significantly as an important ecological factor. Soil formation is due to the natural weathering process of rocks into smaller particles. Soil or sediment is an integral part of an aquatic ecosystem which is significant due to complex reactions which occur and also due to exchange of chemicals between soil and water. (Shaikh Parveen R. et al., 2013). Pedology is the study of soil. Patalganga river flowing in Raigad district, Maharashtra is a significant source of water supply to Khopoli township, Khalapur area and Patalganga industrial area. Most of the industries in India are situated along the river banks. Lokhande et al, 2011 studied the physico - chemical properties of industrial waste water effluent and reported high level of pollution along Taloja Industrial belt of Mumbai. The partially treated or untreated effluents released from industries along with anthropogenic activities has led to water pollution of the Patalganga river. The polluted water percolates the river bed affecting the river fauna, moreover leading to soil pollution. Industrial effluents along with domestic sewage through drainages of Sina river near Ahmednagar city have reported soil pollution. (S. S. Patil et al.2014). In river ecosystem, the soil quality is an essential component to maintain sustenance of aquatic flora and fauna. Besides, nutrients present in the soil provide agricultural benefits to the farmer. The characteristics of soil from catchment area ofManjara river, Nanded, Maharashtra were found suitable for cultivation of crops (NitinM. Sahajrao and Rajkumar G. Pawale, 2014). Regular monitoring of physico - chemical parameters of soil is essential for crop yield (Jadhavar, 2019). Heavy metal soil pollution was reported along wetland of Thane Creek of Maharashtra (Singare et. al.2010). In India although the industries follow environmental guidelines of Pollution Control Boards there seems to be lacunae in management of industrial waste water and solids especially from industries present along the river banks.

Hence, the present investigation was undertaken to study the physico chemical properties of soil from the banks of Patalganga river to assess the soil pollution in the area.

2. Materials and Methods

Patalganga river is located at 18.48°N 73.4°E in Raigad district, Maharashtra. Different villages in the vicinity of the river were identified and soil samples were collected in clean and sealed plastic bags from seven different sites - Khopoli, Vayal, Rasayani, Chavane, Apta, Kasarbhat and Aware along the river belt. The pre monsoon and monsoon samples were collected from riverbanks, for the months January, February, March, April, May and June 2019. The physico - chemical parameters - temperature, pH, texture, moisture content, organic content, bulk density and water holding capacity were studied using standard methods. Temperature of the soil was noted by placing the thermometer in the soil. pH of the soil was noted using digital pH meter. The texture of soil was determined by using the hydrometer test. (Gee and Bauder, 1986.) For moisture content 10 gm of soil sample was weighed and then kept in the oven at 105^0 C for 24 hours. From the dry weight and the wet weight the percentage of moisture content was calculated. Organic content was analysed by Titration method (Walkley and Black, 1934). Soil bulk density and water holding capacity was measured by standard methods.

Map showing study area - Patalganga River in Raigad District, Maharashtra, India

3. Results and Discussion

In the present investigation, the physico - chemical analysis of soil samples from Patalganga river were studied (Fig.1, 2, 3, 4, 5 and 6). Soil temperature varies in response to exchange processes that take place primarily through the soil surface. (Shaikh Parveen R. et al., 2013). In the pre - monsoon months a steady increase in the **temperature** was observed followed by decline in the month of June at all the sites. Highest temperature was noted at Aware in the month of May and the lowest at Khopoli in the month of January. Temperature ranged between 23^0 C to 30^0 C. (fig.1)

The **pH** can affect the availability of nutrients in the soil. (Nitin M. Sahajrao et al., 2014). Except Apta all the sites showed the soil pH range >7, wherein a steady range of acidic pH was observed at Apta. This may be due to the anthropogenic activities of many locals residing in the vicinity. Rasayani and Chavane showed a gradual decrease in pH ranging from pH 9 to pH 6 from January to June. A high pH value 8.9 was observed at Aware in the month of February while lowest pH 6.1 at Chavane in the month of June. (fig.2). Similar findings of soil pH value pH 5.8 to pH 8.5 were reported by Nontobeko Gloria Maphuhla et al., 2020, pH values observed were in between pH 6.1 to pH 8.9. Alex van Herk, 2012 reported the pH of soils from the Gongulon agricultural sites ranged from 5.98 to 7.26. pH of soil also shows bottom decomposition of aquatic ecosystem. (Ramachandra T. V. et al.2012). The seasonal variations, effluents and the rain water runoff entering in the Patalgangariver may have accumulated some salts in the soil, thereby showing the change in pH.

Texture In the soil the proportion of sand, silt and clay contribute to soil texture. Soil also contains organic matter which includes living biomass, detritus and humus. Humus is an dark coloured amorphous, colloidal mixture of end products derived from decomposition of plant and animal residues along with carbohydrates, proteins, lignins, lipids and organic acids. Humus helps to withhold water and nutrients important for plant growth and also the soil to stick together which allows nematodes, or microscopic bacteria, to easily decay the nutrients in the soil. (Shaikh Parveen R. et al., 2013). A typical soil profile contains different layers also called horizons, at the surface large amounts of loose and partly decomposed organic matter in varying stages of decomposition is found andthe top soil is rich in humus mixed with mineral matter and dark in colour. While, the subsoil contains little organic material and accumulation of minerals transported from above layers, it is referred as zone of accumulation. Between the top soil and the subsoil there is a layer that has leached off its mineral or organic content resulting into a pale coloured layer mainly of silicates, the zone of eluviation. Another layer, the parent rock is made up of partially weathered parent material present on the bedrock. The percolation of surface pollutants alter the composition and texture of the soil and often lead to soil degradation. S. S. Patil et al.2014 reported percolation of surface pollutants due to industrial effluents and domestic sewage in the Sina river, Ahmednagar. In the present investigation, sandy clay texture was observed at all sampling sites except in Chavane, Kasarbhat and Aware which showed loam and loamy clay soil texture. In the month of May, Aware showed presence of silt, which may be owing to the summer and it being the last downstream site. The soil samples in the study area show 21 samples are sandy clay, 13 samples are clay, 2 samples are loam and 1 sample each of loamy clay, sandy, loamy, sandy loam, loamy clay and silt respectively. The stickiness of the clay and the floury nature of the silt are balanced by non - sticky and gritty characteristics of the fine to coarse sands. (C. E. Millar and L. M. Turk, 1954).

Moisture content showed a sharp decline in the month of March owing to the high temperature as seen in (Fig.3) at all the sites, with highest decline observed at Apta. Highest and lowest moisture content was observed at Rasayani in January and Apta in March respectively. Moisture content varied from 1% to 36%. The moisture content value ranged from 1.5% to 10% in soil samples from Amravati district of

Maharashtra. (Rajesh P. Ganorkar and P. G. Chinchmalatpure, 2013).

The high **Organic content** in the soilobserved at Kasarbhat indicates heavy pollutant load as this sampling site lies downstream catchment of the Patalganga river basin. Organic content of the soil was found to be highest in the month of January with a gradual decrease in the month of February, with sharp decline in the month of March and May, while in April and June a sharp increase was observed at all the sites. Organic content ranged from 1% to 13%. (fig.4)

A gradual decrease was observed in **bulk density** from January to June with highest value at Vayal in the month of January and lowest at Aware in the month of June. All the sites showed lower values of bulk density in the month of June when compared with January. Bulk density ranged between 1.1 gm/cc to 2.8 gm/cc. (fig.5)

Water holding capacity was highest at Vayal in January and lowest at Kasarbhat in June. An overall stiff decline at all sites was observed in March. Water holding capacity ranged from 7% to 90%. The results are supported by the moisture content and organic content. (fig.6).

Sanjoli Mobar et al 2015 reported deterioration of soil quality due to industrial pollution in Jaipur city, India. In the present investigation, low water holding capacity, low moisture content, low organic content and moderate bulk density values were observed in the month of March for all the sites which may be attributed to the seasonal change affecting the nature of the soil. Also the massive increase in urbanization in that region has contributed to soil pollution with corrosion of metals, concrete and debris adding to the pollutant loads. Contaminants added to the soil beyond permissible levels cannot be absorbed through the normal nutrient cycle in the river ecosystem. (S. D. Shankhadarwar, 2015). Hence theytend to accumulate affecting the nature of soil.

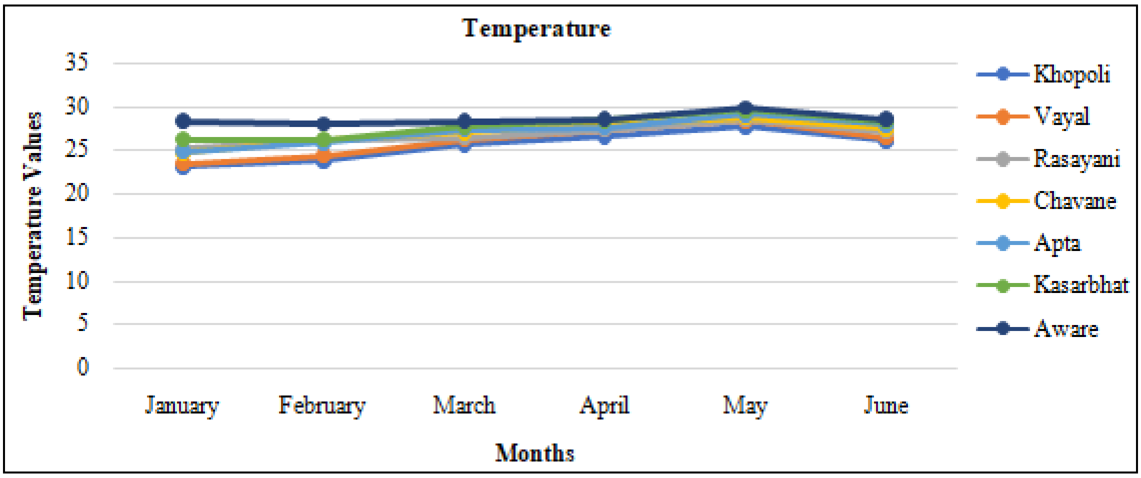

Figure 1: Monthly variations of temperature in Soil from Patalganga River

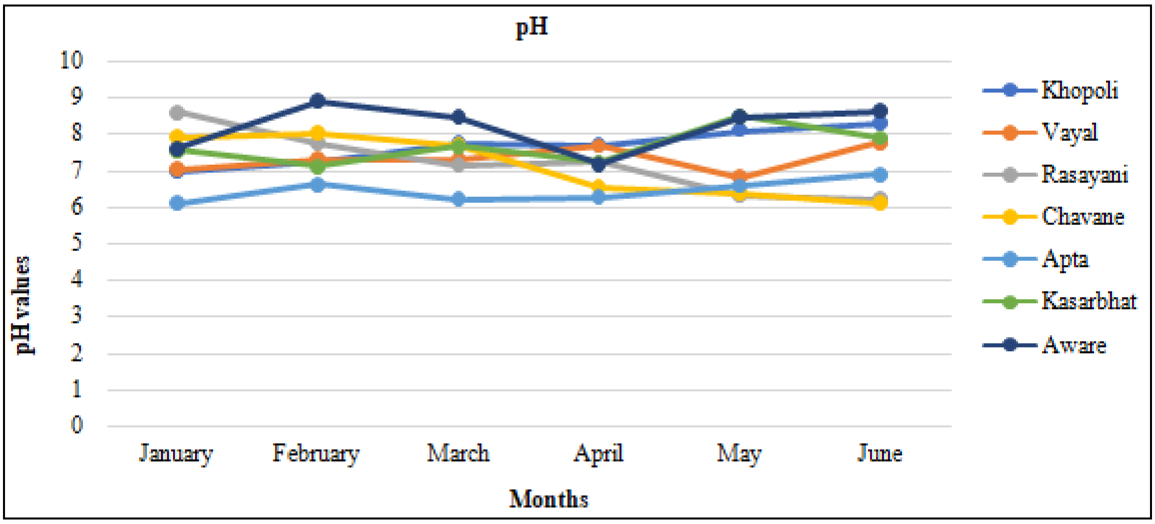

Figure 2: Monthly variations of pH in Soil from Patalganga River

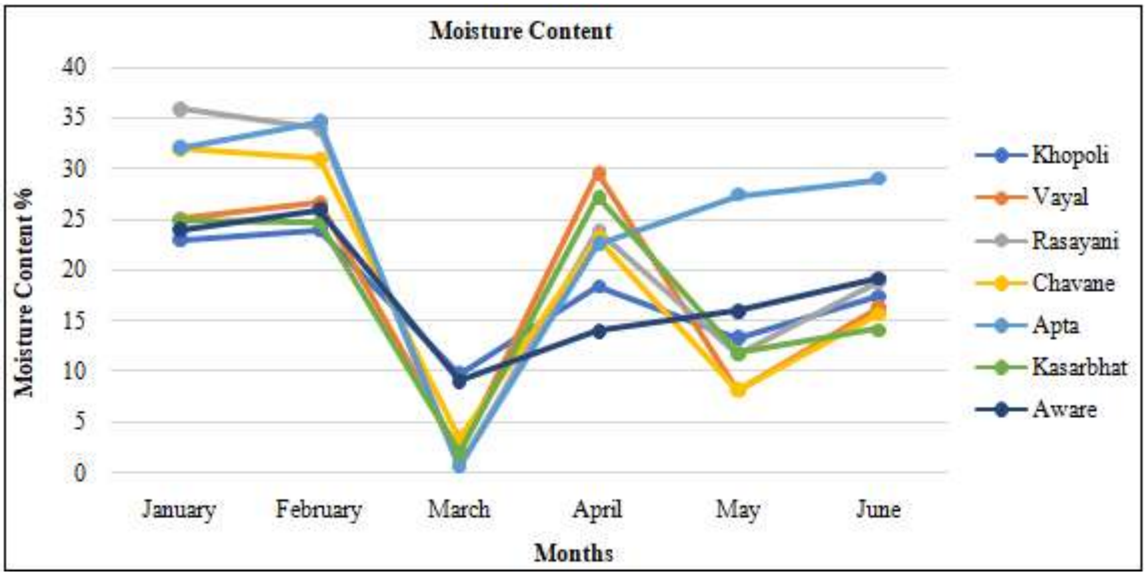

Figure 3: Monthly variations of moisture content in Soil from Patalganga River

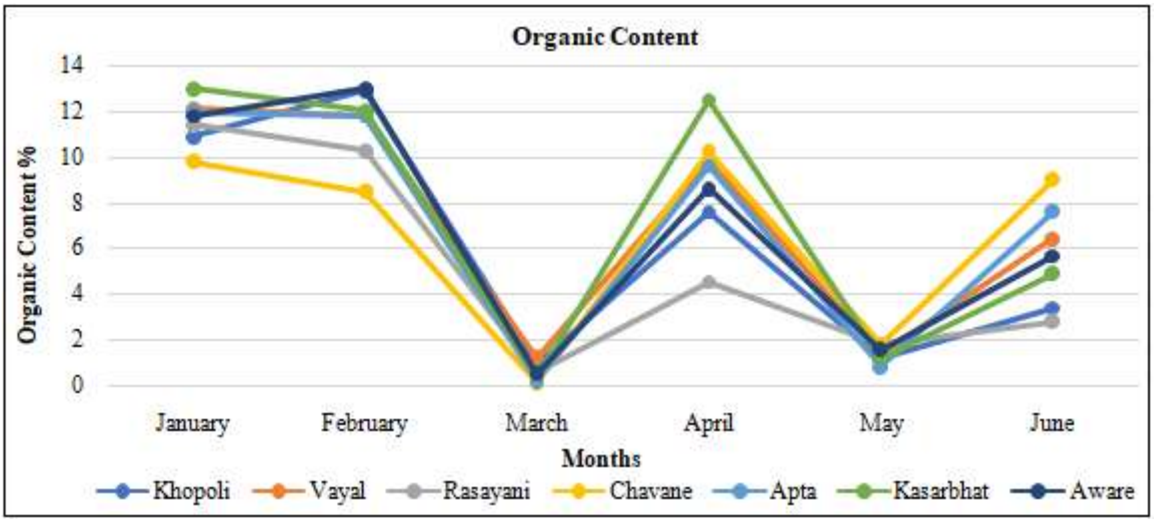

Figure 4: Monthly variations of organic content in Soil from Patalganga River

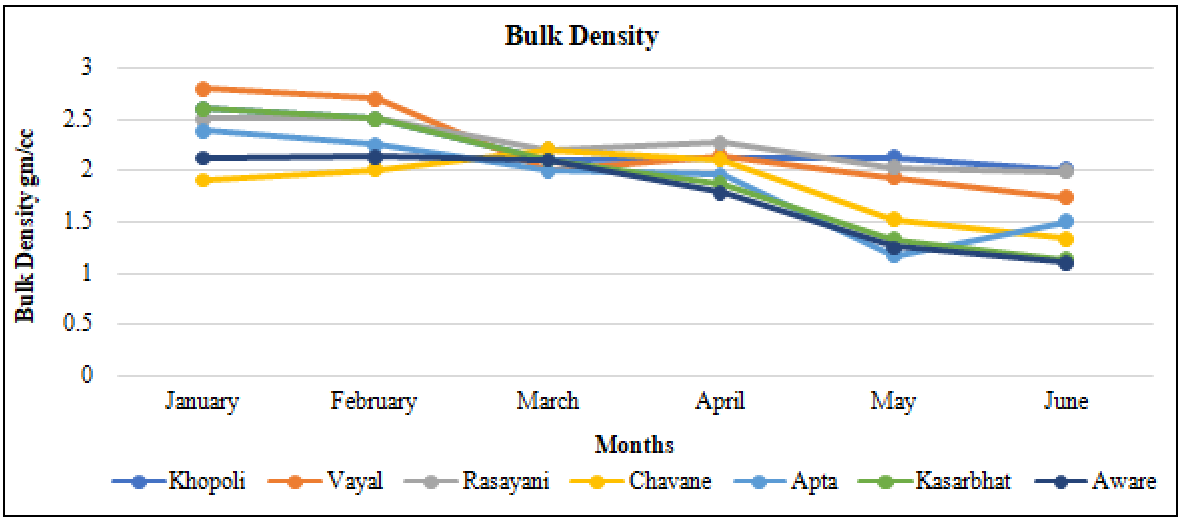

Figure 5: Monthly variations of bulk density in Soil from Patalganga River

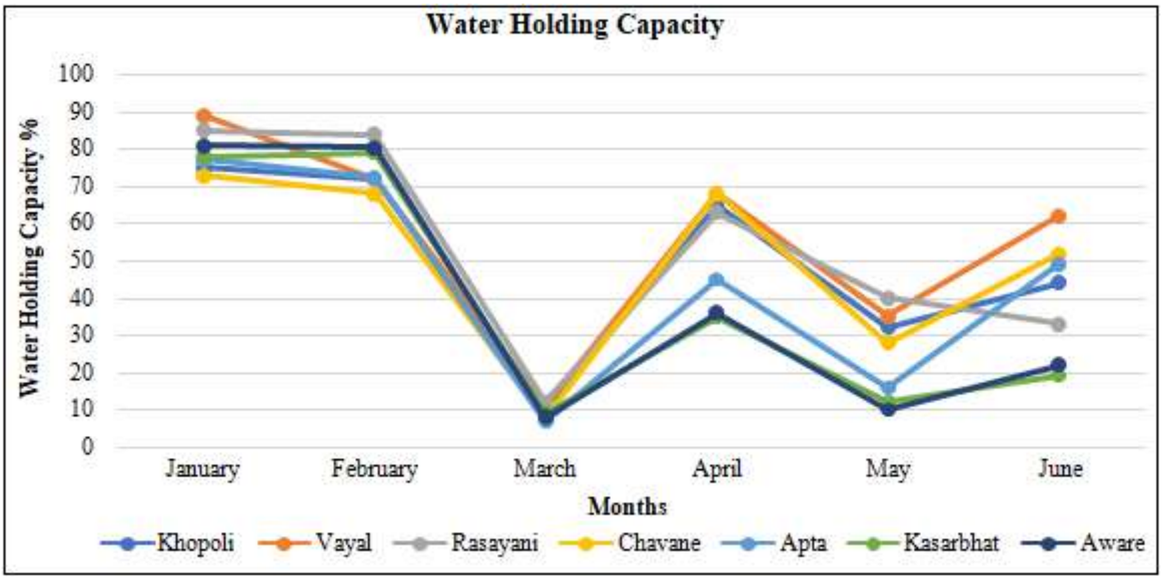

Figure 6: Monthly variations of water holding capacity in Soil from Patalganga River

4. Conclusion

The seasonal variation and the accumulation of pollutants in thePatalganga river affect the nature of soil and thereby the river ecosystem. Hence, constant monitoring of soil pollution is essential to minimize the soil pollution apart from the effects of seasonal variations which nowadays seems tobe more pronounced with adverse climatic changes disrupting human settlements globally. Management of solid waste from industries and human activities along with recycling, reuse and safe disposal is essential to curb soil pollution.

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