EUROPEAN ACADEMIC RESEARCH
Vol. II, Issue 2/ May 2014

Impact Factor: 3.1 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

Assessment of Physicochemical Properties of Soil Samples of Ahmednagar Industrial Area, Ahmednagar (Maharashtra)

S. S. PATIL
H. D. GANDHE
I. B.GHORADE
Dept. of Environmental Science
Dr. Babasaheb Ambedkar Marathwada University
Aurangabad (M. S)
India

Abstract:

The soils in India also classified in eight groups as, red, lateritic, alluvial, black, forest, desert, saline-sodic and peaty and marshy soils. Soil pollution is any chemical or biological alteration of soil that is harmful to living organisms. Virtually all soil pollution is the direct result of sources of pollution on the ground surface. The percolations of these surface pollutants through the soil cause soil degradation. One of the most harmful ecotoxicological effects is that of the eutrophication of water bodies. This occurs due to over use and bad management of phosphorous and nitrogen fertilizers and contaminated wastewater for irrigation. Bioaccumulation and biomagnifications of these poisons as they move along the food chain is also a major problem, which has influence on the whole ecosystem. In addition to the industrialization, the wrong practice of agriculture has also adversely affected the soil and surface as well as groundwater quality. Therefore, the present work was undertaken for the study of Impact of chemical industries on soil quality of Ahmednagar area. Soil samples were collected and analyzed for physico-chemical properties of soil in the study area such as Ph, Alkalinity, Sodium, Potassium, Sulphate, Phosphte, Nitrate ect.

Key words: Soil pollution, Physico-chemical Prosperities, Ecosystem,

Bioaccumulation, Biomagnifications, Irrigation and Weathering.

Introduction

There are two major categories of soil i.e. zonal and drift. The zonal soil occurs usually in relatively flat or undulating areas formed as result of weathering. Where as a drift are formed by mass movement deposits and are thus transported soils. These soils are classed on the basis of minerals, chemical composition and texture (Annon, 1975). On the basis of morphology, nutrient status, quantity of organic matter, color and general climatic consideration soils are placed to ten general categories (Keller, 1976). The soils in India also classified in eight groups as, red, lateritic, alluvial, black, forest, desert, saline-sodic and peaty and marshy soils. Soil pollution is any chemical or biological alteration of soil that is harmful to living organisms. Virtually all soil pollution is the direct result of sources of pollution on the ground surface. The percolations of these surface pollutants through the soil cause soil degradation. Pollution on the ground surface is the cause of most soil pollution. This surface pollution comes from many sources like waste (solid or liquid) disposal practices, spills, agricultural practices and percolation of surface pollutants through unsaturated soil etc. The use of pesticides and fertilizers as well as disposal of effluent in streams or on land has come under scrutiny for many reasons (Prashanthi and Jeevanrao, 1999). One of the most harmful ecotoxicological effects is that of the eutrophication of water bodies. This occurs due to over use and bad management of phosphorous and nitrogen fertilizers and contaminated wastewater for irrigation. Bioaccumulation and biomagnifications of these poisons as they move along the food chain is also a major problem, which has influence on the whole ecosystem. This activity coupled with the use of contaminated water will raise salinity and/or alkalinity of the soil. The saline alkali soil contain appreciable quantities of neutral salts and also enough adsorbed sodium usually more than 15% to the total exchangeable capacity. This soil seriously injures the crops. Cation-exchange capacity of soil is the degree to which a soil can absorb and exchange cations. Cation-a positively charged ion such as NH_4^+, K^+, Ca^{2+}, Mg^{2+}, Fe^{2+}, etc. Soil particles and organic matter have negative charges on their surfaces, so naturally it attract positively charged nutrients and replace negatively charged nutrients. In addition to the industrialization, the wrong practice of agriculture has also adversely affected the soil and surface as well as groundwater quality.

Therefore, the present work was undertaken for the study of Impact of chemical industries on soil quality of Ahmednagar area. Soil samples were collected and analyzed for physic-chemical properties of soil in the study area.

Material and Methods

In the vicinity of Ahmednagar city there are various small industries viz. marble cutting and polishing, automotives etc. continuously adding effluent along with domestic sewage through drainages of the Sina river which get percolated and reused as well water or bore well water for the agriculture. Analysis of the samples was carried out seasonally throughout the year from 2009-10. Each parameter was analysed seasonally. In order to undertake accurate estimation of soil quality, soil analysis were done for the parameters like pH, Sodium, Potassium, Sulphate, Phosphate and Nitrate. These analyses were carried out by referring the standard procedures according of APHA, AWWA, and WPCT, 1995, Trividy, and Goel (1986) and NEERI. The results are expressed as ppm or milligram per liter. In the study, the overall structure of the study area is taken into consideration while selecting the sampling cities.

Results and Discussion:-

Soil and their characteristic are of great important in an agriculture economy. The pH is one of the most important factors in soil quality management. It indicates that acidity, neutrality and alkalinity of soil (Waugh, 2000).

In summer, during the present of study period (2009-10) the pH level in soil was ranged between 6.64 to 7.92. The lower level of pH was recorded in (S1) and higher level was recorded in (S5).

In rainy, pH level in soil was ranged between 6.15 to 6.90. The lower level of pH was recorded in (S5) and higher level was recorded in (S3) in the year (209-10).

In winter (2009-10), pH was ranged between 7.15 to 7.98. The lower level of pH was recorded in (S1) and higher level was observed in (S9).

In the present study pH level was recorded lower in rainy and higher in summer compared to two other seasons **(Table1 to 3; Fig. No. 1 to 7).** The successive effluent in river affected the pH of irrigated soil and lead to accumulation of salts in the soil. Increase in soil pH has significant effect on seed germination (Reddy, 1991).

The pH value of a normal soil can be considered as an index of its exchangeable cation saturation. Hence, the availability of many plant nutrients depends on the pH of the soil. The nutrients like iron (Fe), zinc (Zn), Copper (Cu), manganese (Mn) etc. are available more in acidic than in alkaline soils. In alkaline and calcareous soils, the availability of potassium (K), phosphorus (PO4), iron (Fe) and many minor elements is reduced and hence, the addition of fertilizers carrying these elements is necessary for such soils. Thus, the pH of soil plays a very important role in maintaining the soil fertility.

Alkalinity (mg/l):

When sample is said to be alkaline the concentration of the hydroxyl ions exceeds that of hydrogen ions. Alkalinity is the acid neutralizing capacity of water which depends on the strength of carbonates in a sample and it determines the availability of free carbon which is essential for photosynthesis and is directly related to productivity. In general alkalinity in dam water which increase the support to the diversity of aquatic life. The alkalinity is harmful for irrigation, which leads to the soil damage and crop yield and imparts bitter taste to the water.

Oomachan and Belsare (1986), pointed out that high alkalinity indicates pollution of water and is harmful for domestic purpose, irrigation which leads to the soil damage and crop yield and imparts bitter taste to the water (Patwari 2002; Pondhe, 2005; Machale, 2010; Jadhavar, 2013; Ghorade, 2013).

In summer, during the present of study period (2009-10) the alkalinity level in soil was ranged between 139.86 to 195.29 mg/l. The lower level of alkalinity was recorded in (S4) and higher level was recorded in (S8).

In rainy, alkalinity level in soil was ranged between 124.24 to 198.18 mg/l. The lower level of alkalinity was recorded in (S2) but in (S6) it was reported to be at higher level. In winter (2009-10), alkalinity level was ranged between 225.14 to 267.75 mg/l. The lower level of alkalinity was reported in (S5) but in (S10) it was reported to be at higher level.

In the present study alkalinity level was recorded lower in summer and higher in winter compared to two other season **(Table1 to 3; Fig. No. 1 to 7).** High value of alkalinity was observed in winter due to the anaerobic sediments, bacteria reduce nitrate to ammonium and NP; phosphorus remains soluble because it does not form insoluble compounds with metals under these conditions (Auti, 2002; Matkar, 2008; Machale, 2010; Wagh, 2012; Jadhavar, 2013; Ghorade, 2013).

Sodium (mg/l):

High concentration of sodium and potassium in water adversely affects the soil structure reported by (Goltrman et.al., 1978; Chandra Prakash, 2001; Pondhe, 2005). The adverse effect on the soil caused by high Na+ concentration is known as sodium hazard (USDA, 1954). The high concentration of sodium affects soil permeability, texture and leads in reduction of water intake. It acts deflocculating agent and displaces the divalent cations like calcium, magnesium and cumulatively the soil losses its productivity.

Many times use of poorer quality of waters has led to the deterioration of the soils. The surface water contain high concentration of salts, often representing disproportionate amount of bicarbonate (HCO_3^-) and sodium (Na^+) ions cause adverse effects on the soils. The studies on effect of irrigation waters on the soil properties have been carried out by several workers (Hausenbuiller et. al., 1960; Madhav Rao et. al., 1979).

In summer, during the present of study period (2009-10) the sodium content in soil was ranged between 135.65 to 199.16 mg/l. The lower level of sodium was recorded in (S6) and higher level was recorded in (S2).

In rainy, sodium content in soil was ranged between 88.14 to 125.37 mg/l. The lower level of sodium was recorded in (S1) and higher level was recorded in (S4).

In winter (2009-10), sodium content was ranged between 82.22 to 98.48 mg/l. The lower level of sodium was reported in (S1) and higher level in (S7).

In the present study sodium level was recorded lower in winter and higher in summer compared to two other season **(Table1 to 3; Fig. No. 1 to 7).** The ratio of sodium to total cations is important in agriculture and human pathology. Soil permeability can be harmed by a high sodium concentration (APHA, 1995). There are no health based drinking water standards for sodium and potassium.

Potassium (mg/l):

Potassium is essential as plant nutrients. It originates from mineral weathering, inorganic fertilizers and soil amendments viz. gypsum, composts and manures and irrigation waters (Koch et.al., 1980). Potassium of potash (K) regulates plant processes such as water balance, transpiration, photosynthesis, and resistance to disease, cold and drought. Potassium deficiency symptoms vary widely (Auti, 2002).

In summer (2009-10), potassium content was ranged between 62.15 to 74.13 mg/l. The lower level of potassium was reported in (S3) but in (S10) it was reported to be at higher level.

In rainy, during the present of study period (2009-10) the potassium content in soil was ranged between 63.23 to 69.89 mg/l. The lower level of potassium was recorded in (S6) and higher level was reported in (S10).

In winter, potassium content in soil was ranged between 63.22 to 69.15 mg/l. The lower level of potassium was recorded in (S1) but in (S3) it was reported to be at higher level.

In the present study potassium content was recorded lower in summer and higher in rainy. **(Table1 to 3; Fig. No. 1 to 7).**The major source of potassium in natural water is weathering of the rocks but the quantities increases in the polluted water due to disposal of waste water. It has a similar chemistry like sodium and remains mostly in solution without undergoing any precipitation. It also enters the exchange equilibrium of the adsorbed cations. As such, it is not very much significant from the health point of view but large quantities may be laxative (Trivedy and Goel, 1986).

Sulphate (mg/l):

Sulpher exist in number of oxidation state, from the most oxide sulphate to the most reduced sulphide. The biological reduction of sulpher can take place in both aerobic and anaerobic conditions. Under the aerobic condition reduction of sulphate is assimilatory process (Tuttle, 1980), whereas under anaerobic condition specialized group of bacteria use sulphate as a terminal electron acceptor and form hydrogen sulphide. The sulphate reducing bacteria are also terminal oxidizers of organic matter in sulphate rich humid environment.

Suplhates are soluble in water and can directly be determined in the soil solution. Sulpahte like chlorides corrode steel and affect the solidity and strength of concrete, sodium sulfate causes foaming, sulphate cause laxative effect. Sulphate in exists of 250 mg/l causes gastrointestinal irritation. In addition to domestic sewage industrial effluents also add sulphates to aquatic environment and hence high level of sulphate is an indicator of organic pollution. Sulphate itself has never been a limiting factor for water bodies as it dissolves in water easily while flowing with running water. In normal level, sulphate is more than enough to meet plants need. If the concentration exceeds above 500 mg/l it has laxative effect and cause gastro intestinal irritation (Hassan, et. al., 2013).

In summer, during the present of study period (2009-10) the sulphate content in soil was ranged between 131.21 to 193.42 mg/l. The lower level of sulphate was recorded in (S1) and higher level was reported in (S2).

In rainy, (2009-10) sulphate content in soil was ranged between 235.46 to 294.69 mg/l. The lower level of sulphate was recorded in (S5) and higher level of sulphate was recorded in (S4).

In winter (2009-10), sulphate content was ranged between 181.36 to 189.92 mg/l. The lower level of sulphate was reported in (S9) and higher level in (S4).

In the present study sulphate content was recorded lower in summer and higher in rainy compared to two other seasons **(Table1 to 3; Fig. No. 1 to 7).** Sulphate ions usually occur in natural water. Many sulphate compounds are redily soluble in water. Most of them originate from the oxidation of sulphide ores, the solution of gypsum and anhydrite, the presence of shales, particularly those rich in organic compounds and the existence of industrial wastes. Sulphur-bearing minerals are common in most sedimentary rocks. In the weathering process gypsum (calcium sulphate) is dissolved and sulphide minerals are partly oxidized, giving rise to a soluble form of sulphate that is carried away by water.

Phosphate (mg/l):

Phosphates, mostly in the form of PO_4^{-3} are available in large quantities on agricultural lands as it is applied as a fertilizer, Polyphosphates used in water may combine with Ferric oxide to form a glassy phosphate films. Phosphorus like nitrogen is a good nutrient and encourages the growth of bacteria and aquatic plants. As a nutrient excess of phosphate stimulates development of algal blooms.

In summer, during the present of study period (2009-10) the phosphate content in soil was ranged between 131.21 to 193.42 mg/l. The lower level of phosphate was recorded in (S1) and higher level was reported in (S2).

In rainy, phosphate content in soil was ranged between 1.52 to 3.64 mg/l. The lower level of phosphate was recorded in (S2) and higher level of phosphate was recorded in (S8).

In winter (2009-10), phosphate content was ranged between 3.34 to 4.62 mg/l. The lower level of phosphate was reported in (S2) but in (S10) it was reported to be higher level.

In the present study of both the year (2009-11) phosphate content was recorded lower in rainy and higher in winter compared to two other seasons **(Table1 to 3; Fig. No. 1 to 7).**Phosphates and nitrates are the main nutrients responsible for the process of eutrophication that leads to ultimate environmental degradation (Kodarkar et.al.,1991; Kodarkar and Chandrasekhar, 1995). Phosphate in the nature present mostly in inorganic forms. The major sources of phosphate are domestic sewage, detergents, agricultural effluents with fertilizers and industrial wastewaters. The higher concentration of phosphate is a indicator of pollution (Kodarkar, 1995; Malahti, 1999 and Anitha, 2002). Phosphate and nitrate are the main nutrients responsible for the process of eutrophication that leads to ultimate environmental degradation (Reynolds, 1991 and Kodarkar et.al.,1991). Jensen and Andersen (1990) discussed the possibility that blooms green which are often associated with NO_3 - levels in the lake decreased the sedimentation. Phosphorus (P) contributes to root growth, fruit growth and disease resistance (Auti 2002; Podhe, 2005; Matkar, 2008; Shinde, 2008; Machale, 2010).

Nitrate (mg/l):

Nitrogen is a major constituent of the earth's atmosphere and occurs in many different gaseous forms such as elemental nitrogen, nitrate and ammonia. Natural reactions of atmospheric forms of nitrogen with rainwater resulted in the formation of nitrate and ammonium ions. While nitrate is a common nitrogenous compound due to natural processes of the nitrogen cycle, anthropogenic sources have greatly increased the nitrate concentration, particularly in surface water. The largest anthropogenic sources are septic tanks, application of nitrogen-rich fertilizers to turfgrass, and agricultural processes (Pondhe, 2005).

In summer, during the present of study period (2009-10) the nitrate content in soil was ranged between 2.13 to 2.41 mg/l. The lower level of nitrate was recorded in (S8) but in (S5) it was reported to be at higher level.

In rainy, nitrate content in soil was ranged between 2.42 to 3.89 mg/l. The lower level of nitrate was recorded in (S6) and higher level of nitrate was reported in (S8).

In winter (2009-10), nitrate content was ranged between 2.30 to 2.69 mg/l. The lower level of nitrate was reported in (S3). The higher level reported in (S4).

In the present study period of (2009-10) nitrate content in soil was recorded lower in summer and higher in rainy compared to two other seasons while during the second year (2010-11) the nitrate content was lower in summer and higher in rainy compared to two other seasons **(Table1 to 3; Fig. No. 1 to 7).** Nitrate is a problem as a contaminant in surface water and (primarily from groundwater and wells) due to its harmful biological effects. High concentrations can cause methemoglobinemia, and have been cited as a risk factor in developing gastric intestinal cancer (Pondhe, 2005).

Nitrate is found in surface soil water only when they are badly polluted by sewage. Extensive usage of nitrogenous fertilizers such as urea and Ammonium sulphate has sufficiently polluted ground as well as surface water with nitrate.

Surface runoff in urban areas modifies and degrades stream water and sediments to detriment of abstract drinking water, recreational users and the aquatic and riparian ecology (Chandler, 1994; Ellis and Hvitved- Jacobsen, 1996). Improvement in the chemical quality of water in the UK and elsewhere has been achieved through large scale curtailment of point source discharges and upgrading of combined sewer outflows, but these mitigation measures have highlighted the impact of non-point source pollution particularly storm water runoff from urban structures, pavements, streets, roofs, guttering and buildings (Marsalek, 1990). This is of major concern for managers of freshwater ecology and consideration of the principal, critical, limiting factor in achieving ecological integrity in urban watercourses (Characklis and Wiesner, 1997). Contamination of water and attachment of pollutants to streambed sediments impair aquatic flora and fauna. Macro-invertebrates at the base of the food chain are particularly vulnerable and therefore can act as indicator of a rivers biological health. An effort to characterize more accurately the cumulative impact of human activities on ecosystems, monitoring is slowly moving away from reliance on chemical indicators towards use of ecological measures (McCormick and

Carins, 1994. Urban runoff entrains sediments that accumulate on surfaces between runoff contained 250 to 300 mg/l of suspended sediments Upon reaching the receiving water body the majority of the sediment settled is the principal underlying reason for reduced bio-integrity with reasons well summarized by Pawar et.al.,(1977).

Various toxic contaminations that are found in rarely detectable amounts in the water column can accumulate in sediments at much higher level. Sediments can serve as both a sink for contaminants and a source of contaminants to the water colum and organisms. Short term input of suspended sediment from construction sites have been shown to reduce the abundance of fish and invertebrates during and after construction (Ogbeibu and Victor, 1989). The time scale of construction, soil, climate, the size of receiving water body, the hydrobiology pathways linking the construction area with receiving watercourse and the historic records of sedimentation and contamination in the catchment (Catallo and Gambrell, 1987).

Table 1: Physico-Chemical Properties of Soil Samples from the study area for Summer season in the year 2009-2010

Satiation No.	pH	Alkalinity	Sodium	Potassium	Sulphate	Phosphate	Nitrate
S1	6.64	164.65	167.24	68.21	131.21	2.49	2.22
S2	6.79	143.56	199.16	66.83	193.42	2.92	2.39
S3	6.82	191.53	160.19	62.15	144.93	2.66	2.37
S4	7.63	139.86	166.24	68.56	155.84	3.12	2.39
S5	7.92	166.74	153.86	66.84	165.92	3.58	2.41
S6	7.55	148.13	135.65	65.22	166.15	3.39	2.34
S7	7.69	152.26	163.14	68.11	196.13	3.68	2.29
S8	7.35	195.29	196.12	66.22	187.19	3.52	2.13
S9	7.69	163.56	188.26	65.26	156.78	3.68	2.34
S10	7.58	190.16	159.63	74.13	167.55	3.79	2.27

* All values excepts pH are in mg/liter

Table 2: Physico-Chemical Properties of Soil Samples from the study area for Rainy season in the year 2009-2010

Satiation No.	pH	Alkalinity	Sodium	Potassium	Sulphate	Phosphate	Nitrate
S1	6.54	166.23	88.14	69.68	271.14	2.31	2.95
S2	6.25	124.24	99.18	67.67	262.15	1.52	2.87
S3	6.90	145.38	92.16	68.13	293.16	1.65	2.44
S4	6.85	167.42	125.37	69.88	254.15	2.41	2.54
S5	6.15	189.43	89.21	69.14	294.69	2.34	2.68
S6	6.30	198.18	99.19	63.23	235.46	2.95	2.42
S7	6.29	130.26	108.65	65.14	266.14	3.53	3.50
S8	6.84	142.13	107.59	66.16	247.16	3.64	3.89
S9	6.66	154.55	88.15	64.17	257.93	3.57	3.56
S10	6.42	185.16	92.16	69.89	276.11	3.49	3.39

* All values excepts pH are in mg/liter

Table 3: Physico-Chemical Properties of Soil Samples from the study area for Winter season in the year 2009-2010

Satiation No.	pH	Alkalinity	Sodium	Potassium	Sulphate	Phosphate	Nitrate
S1	7.15	236.21	82.22	63.22	186.24	3.56	2.50
S2	7.16	229.22	84.13	66.23	184.81	3.34	2.62
S3	7.18	242.33	85.12	69.15	185.83	3.69	2.30
S4	7.24	234.15	96.13	68.96	189.92	3.95	2.69
S5	7.25	225.14	93.15	64.38	185.14	3.59	2.55
S6	7.26	246.11	92.24	65.89	187.15	3.86	2.66
S7	7.33	257.15	98.48	66.15	186.29	3.66	2.59
S8	7.84	267.44	94.48	64.14	182.38	3.88	2.45
S9	7.98	257.86	95.89	66.12	181.36	3.69	2.68
S10	7.60	267.75	96.95	68.13	183.55	4.62	2.60

* All values excepts pH are in mg/liter

Fig. No.1: Seasonal variations in pH (mg/l) of Soil during the year 2009-10

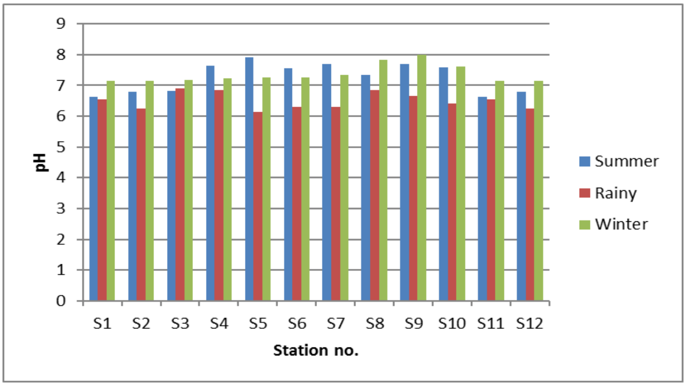


Fig. No. 2: Seasonal variations in Alkalinity (mg/l) of Soil during the year 2009-10

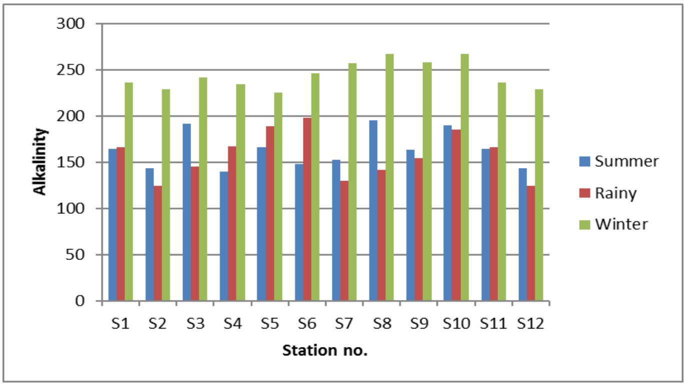


Fig. No. 3: Seasonal variations in Sodium (mg/l) content of Soil during the year 2009-10

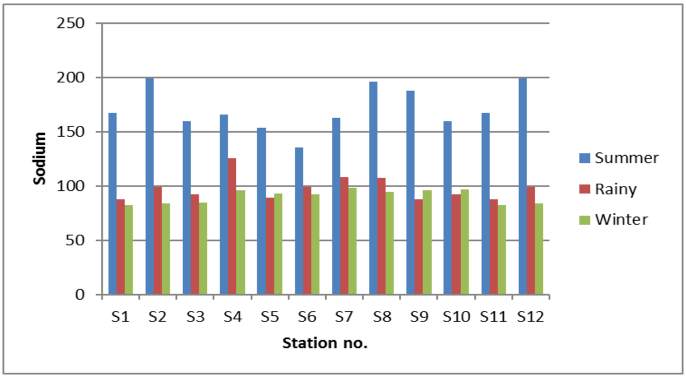


Fig. No. 4: Seasonal variations in Potassium (mg/l) content of Soil during the year 2009-10

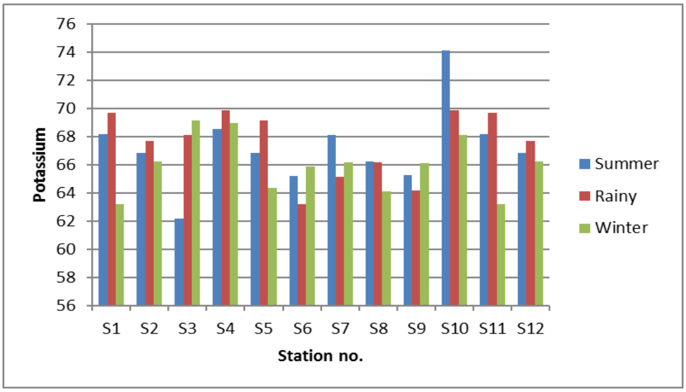


Fig. No. 5: Seasonal variations in Sulphate (mg/l) content of Soil during the year 2009-10

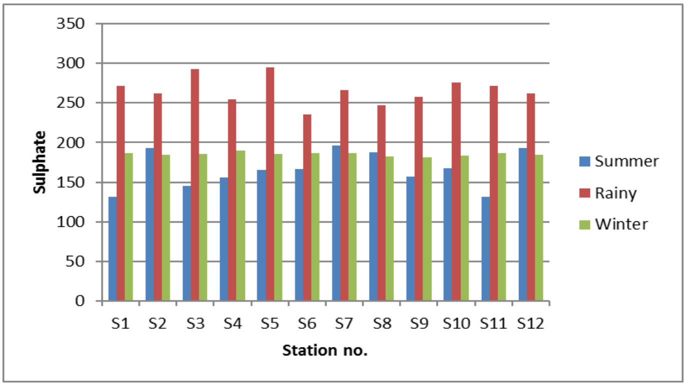


Fig. No. 6: Seasonal variations in Phosphate (mg/l) content of Soil during the year 2009-10

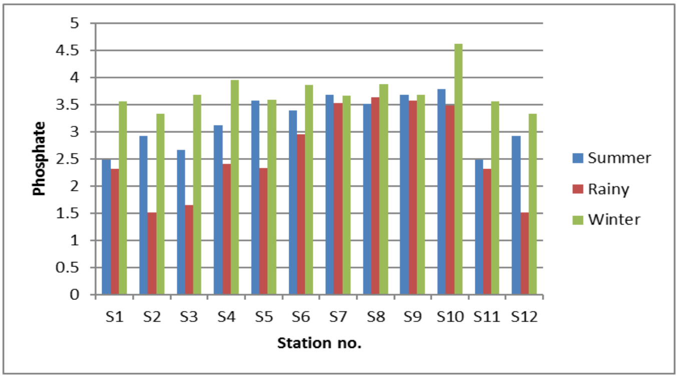
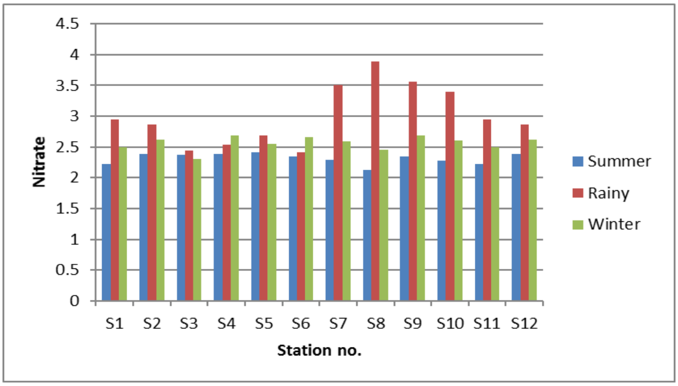


Fig. No. 7: Seasonal variations in Nitrate (mg/l) content of Soil during the year 2009-10



REFERENCES:

American Public Helath Association (APHA), American Water works Association and Water Pollution control Federation. 1995. *Standards Methods for the examination of water and waste water*, edited by A. D. Eaton, Clesceri, L.S., Greenberg, A.E. and Trussel, R.R. (19th Ed.), APHA, Washington D.C.

Anitha, G. 2002. *Hydrography in relation to benthic macro invertebrates in Mir Alam Lake Hyderabad, A.P. Indian.* Ph.D. Thesis submitted to Osmania University, Hyderabad.

Annon. 1975. "What should an Environmental Impact Assessment." In *Environmental Impact Assessment principles and procedures*, edited by R.E. Munn, 190. SCOPE Publ No. 5 New York: John Wiley.

Auti, R.G. 2002. *Seasonal variations in the water characteristics and macrofaunal distribution of Salim Ali Lake near Delhi gate, Aurangabad*. Ph.D. Thesis. Dr. B.A.M. University, Aurangabad.

Catallo, W. J. and R.P. Gambrell. 1987. "The effects of high levels of PAH on sediment physiochemical properties and benthic organisms in a polluted stream." *Chemosphere* 16: 1053-1063.

Chandra, Prakash. 2001. *Status of soil and water quality parameters in brood stalk management*. Course manual CAS. Training programme on Brood stock Management and Genetic selection in fish seed production, CIEF, Mumbai: 129-134.

Chandler, R. D. 1994. "Estimating annual urban nonpoint pollution loads." *Journal of Management in Engineering* 10 (6): 50-59.

Characklis, G.W. and M.R. Wiesner. 1997. "Particles, metals and water quality in runoff from large urban watershed." *Journal of Environmental Engineering* 123 (8): 753-759.

Ellis, J. B. and T. Hvitved-Jacobsen. 1996. "Urban drainage impacts on receiving waters." *Journal of Hydraulic Research* 34 (6): 771-783.

Ghorade, I.B. 2013. *Ecosustainability Assessment of Godavari river water for sustainable Utilization*, Ph.D. Thesis, Dr. B.A.M. University, Aurangabad.

Goltrman, H.L., R.S. Chlymo and M.A.M. Oanhand. 1978. "Method of physicochemical analysis of soil and water." *IBP Handbook No.* (8): 120-122.

Hassan, A.A.S. 2012. *Ground water quality of Aurangabad Industrial Area.* Ph.D. Thesis Dr. B.A.M. University, Aurangabad.

Hausenbuiller, R.L., M.A. Haque and Abdul Wehab. 1960. "Some effects of irrigation waters of different quality on soil properties." *Soil. Sci.* 90: 357-364.

Jadhavar, V.R. 2013. *Impact of Chemical Industries on the water quality of Nagothane-Roha Industrial Area Dist. Raigad (Maharashtra),* Ph.D. Thesis, Dr. B.A.M.University, Aurangabad.

Jensen, H. S. and F.O. Andersen. 1990. "Impact of nitrate and bluegreen algae abundance on phosphorus cycling between sediment and water in two shallow, eutrophic lakes." *Int. Ver. Theor. Angew. Limnol. Verh.* 24: 224-230.

Keller, E.A. 1976. *Environmental Geology*. Columbus (Ohio): Bull and Howell, 488.

Kodarkar, M.S. 1995. "Conservation of Lakes." *IAAB Publication* No. 2 IAAB, Hyderabad.

Kodarkar, M.S., E.V. Muley and Vasant Rao. 1991. "Kukatpally – Hussainsagar, Ecological studies on industrially polluted stream and its impact on freshwater lake in Hyderabad." *(IAAB) publication* 1, 150.

Kodarkar, M.S. and S.V.A. Chandrashekhar. 1995. "Conservation of lake with special reference to water bodies in and around Hyderabad." *IAAB Pub*. 3: 82.

Lenat, D. R. and J.K. Crawford. 1994. "Effects of land use on waterquality and aquatic biota of three North Carolina piedmont streams." *Hydrobiologia* 294: 185-199.

Machale, R.G. 2010. *Impact of Agro-Based Industries on the Groundwater quality of Rajuri (Navgan) area District Beed.* Ph.D Thesis Dr. B.A.M.University, Aurangabad.

Madhavrao, A.R., V.M. Katti and S. Panchakshraiah. 1979. "Effect of Saline water on chemical properties and microbiological population in black soil in Mysor." *J. Agric. Sci*. 13: 262-264.

Madhusudhana Reddy, P., N. Subba Rao and B.R. G. Reddy. 1991. "Hydrogeochemcial studies in Seetammadhara of the Visakhapatnam urban area." *Indian Journal of Environmental protection* 11 (8): 601-604.

Manual on Water and wastewater analysis. 1986. National Environmental Engineering Research Institute (NEERI). Nehru Marg, Nagpur.

Marsalek, J. 1990. "Evaluation of pollutant loads from urban non-point sources." *Water Science and Technology* 22(10): 23-30.

Matkar, R.R. 2008. *Eco-Sutainability Assessment of Godavari* *river water at Jaikwadi Dam supplied to Aurangabad City*. Ph.D. Thesis Dr. B.A.M.University, Aurangabad.

McCormick, P. V. and J. Cairns. 1994. "Algae as indicators of environmental change." *Journal of Applied Phycology*. (6): 509-526.

Ogbeibu, A. E. and R. Victor. 1989. "The effects of road and bridge construction on the bank-root macro benthic invertebrates of a southern Nigerian stream." *Environmental Pollution* 56: 85-100.

Oomachan, L. and D.K. Belsare. 1986. "Bottom sediments and bathymetric distribution of oligocaetes in the lower lake of Bhopal." *J. Hydrobiol*. 2 (4): 57-60.

Patwari, J.M. 2002. *Water and soil characteristics of a pond at Nandrabad on the habitat of bivalve Lamellidens corrianus*. Ph.D. Thesis. Dr. B.A.M. U. Aurangabad.

Pawar, S.S., M.S. Kachole and A.G. Mahajan. 1977. "The toxicity of eldrin and the effect of pretreatment of pherobrabital and hexobarbital on the mortality of freshwater fishes." *Bull. Environ. Conta. Toxicol*. 16: 768-770.

Pondhe, G.M. 2005. *Impact of Agrobase Industries on the ground water quality of Sonai area district Ahmednagar*. Ph.D. Thesis, Dr. B.A.M. University, Aurangabad.

Prashanthi, V. and K. Jeevanrao 1999: Impact of land disposal of industrial effluent on properties of soil of Noor Mahammed lakebed. *J. Envn. Biol*. 20 (3): 271-274.

Shinde, S. 2008: Physicochemical characteristic of Harsul dam at Aurangabad. Ph.D. Thesis Dr. B.A.M. University, Aurangabad.

Trivedi, R.K. and P.K. Goel. 1986. *Chemical and biological methods for water pollution studies*. Environmental publication, Karad, p. 215.

Tuttle, J.H. 1980. "Organic carbon utilization by the resting cells of thiosulphate oxidizing marine heterotrops." *Appl. Enviro. Microbiol.* 41: 516-521.

Wagh, M.D. 2012. *Ground water chemistry of Agrobased Industrial area of Deola, Dist. Nashik*. Ph.D. Thesis, Dr. B.A.M. University, Aurangabad.

Wagh, N.S., M.Y.Khan, S.R. Thorat and S.B. Wagh. 2000. "Study of physicochemical parameters of Pharmaceutical industry at Aurangabad, M.S., India." Proceeding on Environmental Issues and Sustainable Development of National Symposium held at Dr. B.A.M. University, Aurangabad, pp. 66-67.