Assessment of Groundwater Quality of Chaka, Karchana and Kaundhiyara Blocks of Allahabad District.

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ABSTRACT

Water is indispensable for the existence and survival of life on this planet, it required in almost every sphere of human activity. Groundwater is more valuable than surface water and groundwater pollution is one of the environmental problems in many cities of the developing countries due to different human activities. The quality of water usually described according to its physical, chemical and biological characteristics. Thus the analysis of the water quality is very important to preserve and prefect the natural eco system. The 10 Physico – chemical parameters of water samples of three blocks Chaka, Karchana and Kaundhiyaar blocks of Allahabad District were analyzed using standard procedures to ascertain the ground water quality and the results obtained during the experiment are compared with Indian Standard of Drinking water. The results are as follow pH, EC, Total Dissolved Solid, Chloride, Nitrate were under permissible limit and Calcium Hardness, Magnesium Hardness, Total Hardness and sulphate exceeds the permissible limit at all sites of selected blocks.

Keywords: Ground water, Physico-chemical parameters, Water quality, Pollution

I. INTRODUCTION

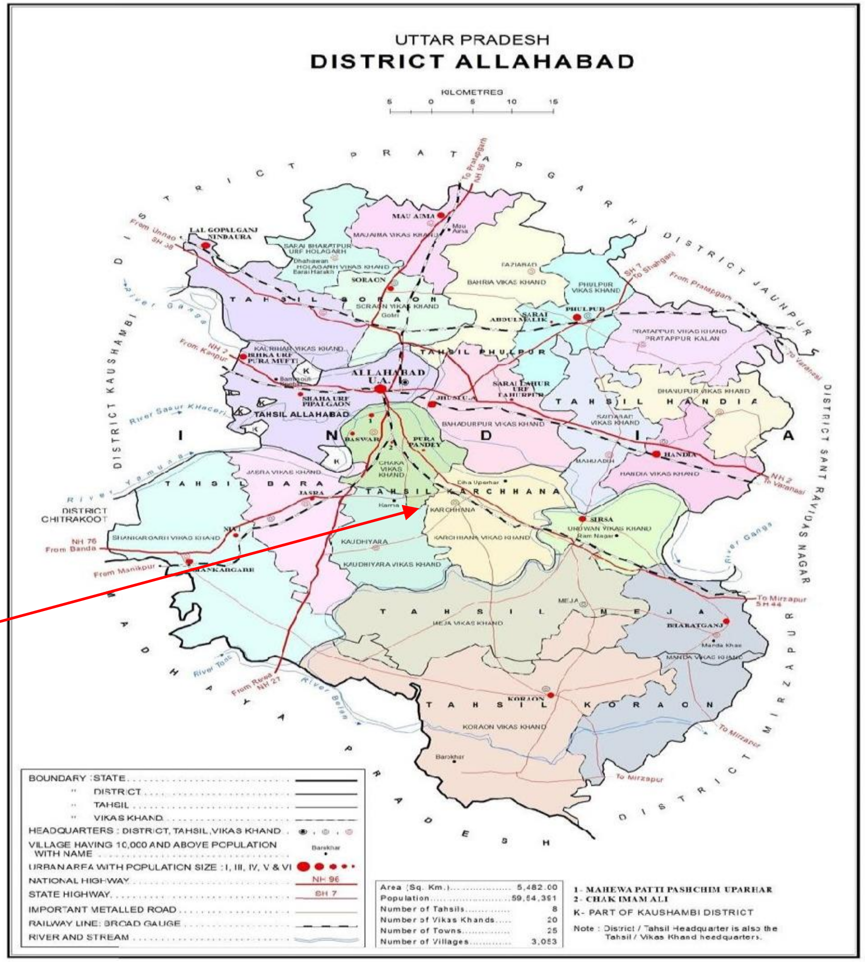
Water is the most important in shaping the land and regulating the climate. It is one of the most important compounds that profoundly influence the life **(S.P. Gorde and M.V. Jadhav).** Groundwater is used for domestic and industrial water supply and also for irrigation purposes in all over the world **(Devendra *et al.*).** In the last few decades, there has been a tremendous increase in the demand for fresh water due to rapid growth of population and the accelerated pace of industrialization.

According to WHO, about 80% of all the diseases in human beings are caused by water **(Kavitha and Elangovan).** Once the groundwater is contaminated, its quality cannot be restored back easily and to device ways and means to protect it. A groundwater threat is now posed by an ever increasing number of soluble chemicals from urban and industrial activities and from modern agricultural practices. Nevertheless, landslides, fires and other surface processes that increase or decrease infiltration or that expose or blanket rock and soil surfaces interacting with downward-moving surface water, may also affect the quality of shallow groundwater **(Babiker et al., 2007).**

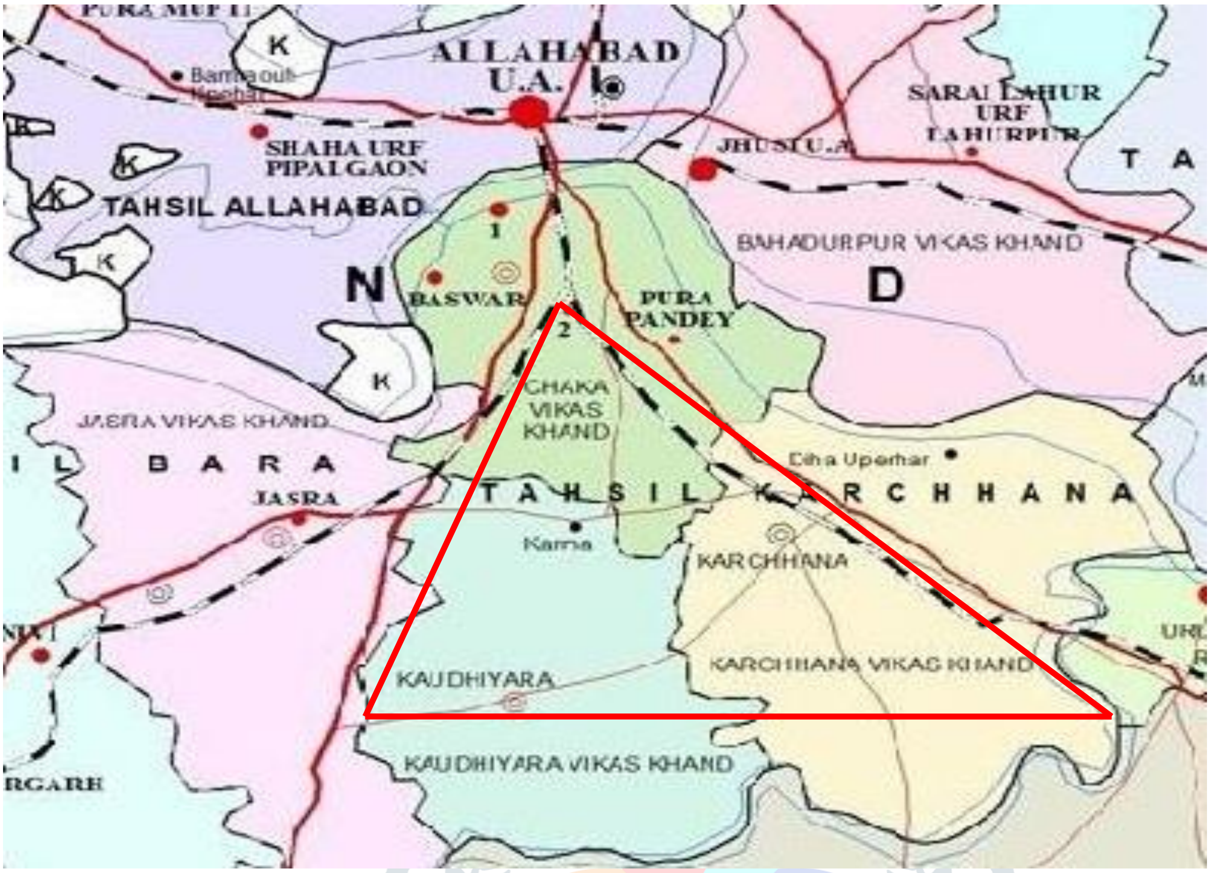
The greater part of the soluble constituents in ground water comes from soluble minerals in soils and sedimentary rocks. The more common soluble constituents include calcium, sodium, bicarbonate and sulphate ions. Another common constituent is chloride ion derived from intruded sea water, connate water, evapotranspiration concentrating salts, and sewage waste. Nitrate can be a natural constituent but high concentrations often suggest a source of pollution. Clean water is essential for human health and integrity of aquatic ecosystems **(Hiyama, 2010).** Water quality standards are needed to determine whether ground water of a certain quality is suitable for its intended use.

Materials and Methods

The experiment was conducted at the Department of Environmental Sciences and Natural Resource management, College of Forestry, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad to ascertain the ground water quality of three block of Allahabad District. The samples were collected from Chaka 25°21'56"-25°24'12"N Latitude and 81°51'10"-81°53'90"E Longitude, Karchhana 25°11'24"-25°17'34"N Latitude to 81'48'31" - 81°59'00"E Longitude and Kaundhiyara Block 25°10'22"-25°28'04"N Latitude, 81°48'31"- 81°83'55"E Longitude.



Map of the selected area of experiment



Map of Selected area of Experiment.

Collection of Sample and Analysis

Water samples were drawn from hand pump of mentioned blocks during January to March 2018 in clean bottles without air bubbles. The sample bottles were rinsed thoroughly with sample water, sealed tightly and labeled in the field after collection. The hand pumps were continuously pumped prior to avoid contamination from the surface. The depth of hand pump was 140-150 feet deep in these blocks. The samples were collected as per the standard methods of water examination, **APHA (1998).** The 90 samples were collected from 10 sites of each block in triplicates systematically and analyzed for ten parameters pH, EC, Total dissolved solid, Calcium Hardness, Magnesium Hardness, Total Hardness, Alkalinity, Chloride, Sulphate and Nitrate as per standards laid by APH/AWWA **(Keith, 1996).** A broad attempt was also been made to compare the results obtained from analysis with Indian standard specification as per IS: 10500:2012 to evaluate the quality of ground water for drinking purposes.

RESULTS AND DISCUSSION

The results of the experiment on pH of water samples of Chaka, Karchana and Kaundhiyaar blocks are presented in table and figure 1 depicted that pH of the water samples ranges from 7.89 to 8.33 in Chaka, 7.82 to 8.52 in Karchana and 7.98 to 8.43 in Kaundhiyara block. The pH of water samples of all blocks were within permissible limit except in Karchana at site Ka1 (Baraha) rest of samples were slightly alkaline in nature.

Water with a high pH level indicates that high levels of alkalinity minerals are present in it. The most prevalent mineral compound causing alkalinity is calcium carbonate, which can come from rocks such as limestone or can be leached from dolomite and calcite in the soil **(Webster *et al.* 2013).**

EC of water samples presented in table1 and figure 2 depicted that EC of water samples ranges from 0.4 to 0.9 dSm^{-1} in Chaka block, 0.4 to 0.8 dSm^{-1} in Karchana and 0.5 to 0.9 dSm^{-1} in Kaundhiyara block. The EC of water samples of all blocks were within permissible limit. EC values can be used to estimate the dissolved solids which may affect the taste of water and suitability for various uses. **(Muthukumaravel *et al.*2010).** Higher conductivity indicates higher dissolved solids in water. As the concentration of dissolved salts (usually salts of sodium, calcium and magnesium, bicarbonate, chloride, and sulfate) increases in water, increases electrical conductivity (**Kelin *et al.* 2005).**

The total dissolved solids (TDS) of water samples presented in table 1 and figure 3 depicted that TDS of the water samples ranges from 235 to 440 mg/l in Chaka block, 235 to 431mg/l in Karchana and 308 to 752 mg/l in Kaundhiyara block. The TDS of water samples of all blocks were within permissible limit. The TDS in water comprises mainly inorganic salts and small amount of organic matter such as carbonate, bicarbonate, chloride, sulphate, nitrate, sodium, potassium, calcium and magnesium.

The most common source of dissolved solids in water is from the weathering of sedimentary rocks and the erosion of the earth's surface. **(Kaushik and Saksena, 1999).** Groundwater usually has higher levels of TDS than surface water, since it has a longer contact time with the underlying rocks and sediments. The concentration of dissolved solids in natural water is usually less than 500 mg/L, while water with more than 500 mg/L is undesirable for drinking and many industrial uses High value of TDS influences the taste, hardness, and corrosive property of the water **(Subhdra *et al*. 2003).**

The Calcium Hardness (Ca) of water samples presented in table 1 and figure 4 depicted that Calcium Hardness (Ca) of the water samples ranges from 102 to 254 mg/l in Chaka block, 129 to 232 mg/l in Karchana and 72 to 116 mg/l in Kaundhiyara block. The Calcium Hardness (Ca) of water samples were within permissible limit except few sites of Chaka C1 (Chak Imam Ali) & C4 (Naini Taluka Naini Dadari) and Karchana K3 (Bardaha), K4 (Ligadahiya), K5 (Chanaini), K7 (Ghatwa) & K10 (Gandhiyawa). Calcium is one of the elements which exist in divalent form Ca^{2+} ion in water **(Goel 2000).** The presence of Ca^{+2}

ions in the groundwater may reflect weathering of rocks such as limestone and aragonite and thus may be considered as the major cation contributor to the water available in the region **(Singh *et al.* 2009)**

Magnesium Hardness (Mg) of water samples are presented in table 1 and figure 5 depicted that Magnesium Hardness (Mg) of the water samples ranges from 354 to 632 mg/l in Chaka block, 346 to 400 mg/l in Karchana and 428 to 586 mg/l in Kaundhiyaar block. The Magnesium Hardness (Mg) of water samples of the selected block exceeds the permissible limit. The magnesium derived from dissolution of magnesium calcite, gypsum and dolomite from source rocks **(Sandeep and Tiwari 2009).** If the concentration of magnesium in drinking water is more than the permissible limit, it causes unpleasant taste to the water **(Sarala and Babu 2012).**

Total Hardness of water samples presented in table 1 and figure 6 depicted that total hardness of the water samples ranges from 534 to 804 mg/l in Chaka block, 529 to 603 mg/l in Karchana and 510 to 701 mg/l in Kaundhiyara block. The Total Hardness of water samples exceeds the permissible limit. Total hardness is caused primarily by the presence of cations such as calcium and magnesium and anions such as carbonate, bicarbonate, chloride and sulphate in water **(Rao *et al*. 1991).** Water hardness has no known adverse effects; however, some evidence indicates its role in heart diseases and hardness of 150-300 mg/l and above may cause kidney problems and kidney stone formation, as it causes unpleasant taste and reduce ability of soap to produce lather. **(Sarala and Babu 2012).**

Alkalinity of water samples presented in table 1 and figure 7 depicted that alkalinity of the water samples ranges from 355 to 530 mg/l in Chaka block, 355 to 481 mg/l in Karchana and 373 to 643 mg/l in Kaundhiyara block. The Alkalinity of water samples of most of the blocks were within the permissible limit except the site Ko4 (643 mg/l). The high alkalinity of groundwater in certain locations in the study area may be due to the presence of bicarbonate and some salts. The alkaline water may decrease the solubility of metals **(Goel 2000)**. Alkalinity is an important parameter in evaluating the optimum dose of coagulant. Excess alkalinity gives bitter taste to drinking water **(Kataria *et al.* 2006).** However, some alkalinity is required in drinking water to neutralize the acids such as lactic acid, citric acid produced in the body **(Kaushik and Saksena, 1999).**

The Chloride of water samples presented in table 1 and figure 8 depicted that Chloride of water samples ranges from 65 to 160 mg/l in Chaka block, 35 to 140 mg/l in Karchana block and 39 to 285 mg/l in Kaundhiyara block. Chloride of water samples of all the blocks were within the permissible limit. The Chloride is present in all the natural waters, mostly at low concentrations **(Patel and Sinha 1998).** Chloride imparts a salty taste and some times higher consumption causes for the development of essential hypertension, risk for stroke, left ventricular hypertension, osteoporosis, renal stones and asthma in human beings. **(Sarala and Babu 2012).**

Sulphate in water samples of Chaka, Karchana and Kaundhiyara block presented in table 1 and figure 9 depicted that sulphate of the water samples ranges from 456 to 945 mg/l in Chaka block, 315 to 765 mg/l in Karchana and 114 to 942 mg/l in Kaundhiyara block. The Sulphate of water samples of most of the blocks exceeds the permissible limit. The standard desirable limit of sulphate for drinking water is 200 mg/l prescribed by BIS, 1991 & is within the permissible limit of 400 mg/l. Sulfates are a combination of sulfur and oxygen and are a part of naturally occurring minerals in some soil and rock formations that contain groundwater. The mineral dissolves over time and is released into groundwater. Gypsum is an important source in many aquifers having high concentrations of sulfate **(Paul, 1999).**

Nitrate of water samples presented in table 1 and figure 10 depicted that Nitrate of the water samples ranges from 6.09 to 9.63 mg/l in Chaka block, 6.49 to 9.9 mg/l in Karchana block and 7.09 to 10.67 mg/l in Kaundhiyara block. Nitrate of water samples of all the blocks were within the permissible limit. Natural Nitrate levels in groundwater are generally very low as it moves relatively slow in soil and groundwater. Nitrate contamination in groundwater arises from point sources such as livestock facilities, sewage disposal systems, including septic tanks and non- point sources such as fertilized cropland, or naturally occurring sources of nitrogen **(Gupta *et al*. 2008).** The acute health hazards associated with drinking water with nitrate creates the condition known as methemoglobinemia (Blue baby syndrome) in which blood lacks the ability to carry sufficient oxygen to the individual's body cells **(Hegesh and Shiloah 1982)**

Conclusions

The results on the Physico – chemical parameters of water samples of three blocks (Chaka, Karchana and Kaundhiyara) of Allahabad are concluded as the pH, EC, Total Dissolved Solid, Chloride, Nitrate were under permissible limit and Calcium Hardness, Magnesium Hardness, Total Hardness and sulphate exceeds the permissible limit at all sites of selected blocks.

Acknowledgement

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References:

APHA (1998) Standard Methods for the Examination of Water and Wastewater. American Public Health Association Inc., Washington, DC.

Babiker, S., Mohamed, M. A. A. & Hiyama, T. (2007) Assessing groundwater quality using GIS. Water resource Manage. Springer science + Business Media B.V.21:699-715.

Devendra Dohare, Shriram Deshpande and Atul Kotiya (2014) Analysis of Ground Water Quality Parameters. *Research Journal of Engineering Sciences.* Vol. 3(5), 26-31, May**.**

Goel P.K., (2000) Water Pollution- Causes Effects and Control, *New Age Int. (P) Ltd.*, NewDelhi.

Gorde, S. P. and Jadhav, M.V. (2013) Assessment of Water Quality Parameters: A Review, *Journal of Engineering Research and Applications*, 3(6), 2029-2035**.**

Gupta, S. K., Gupta, R. C., Chhabra, S. K. Eskiocak, S. and Gupta, A. B. (2008) Health issue related to nitrate pollution in water and air . *Ind. Agric. Environ. Health*, 94: 1469-1477.

Hegesh E, Shilooah J. Blood nitrates and infantile Methemoglobinemia.Clin Chim Acta. 1982; 125:107-115. Doi: 10.1016/0009-8981(82)90187-5.

Hiyama, T. (2010) Evaluation of groundwater vulnerability (and sustainability). 20th UNESCOIHP training course DOI 10. 1007/S11269-006-9059-6.

Kataria H.C., Gupta M., Kumar M., Kushwaha S., kashyap S., Trivedi S., Bhadoriya R. and Bandewar N.K., (2006) Study of Physico- Chemical Parameters of drinking water of Bhopal city with reference to Health impacts ; Current World Environment Vol. 6(1), pp 95-99.

Kaushik, S. and Saksena, D. N. (1999) Physical and chemical limnology of certain water bodies of central India., *Daya Publication House , Delhi*, pp. 1-58.

Kavitha, R. and Elangovan, K., (2010) Review article on Ground water quality characteristics at Erode district, (India), of I.J.E.S., 1(2): pp. 163-175.

Keith, L. H. (1996) Compilation of EPA's Sampling and Analysis Methods, 2nd ed. Lewis Pub./CRC Press, Boca Raton, Fl, 40 pp.

Kelin, H., Yuang, H. F., Hong, L. & Robert, W. E. (2005) Spatial variability of shallow groundwater level, electrical conductivity and nitrate concentration and risk assessment of nitrate contamination in North china plain. *Environment International*, 31, pp.896-903.

Muthukumaravel K. and et al., Evaluation of Ground Water Quality in Perambalur, *Indian Journal of Environmental Sciences*, 14(1), 47-49 (2010).

Pandey Sandeep K. and Tiwari S.,(2009), "Physico-chemical analysis of groundwater of selected area of Ghazipur city-A case study, *Nature and Science*, 7(1).

Patel, N.K. and Sinha, B.K. (1998) Study of the pollution load in the ponds of Burla area near Hirakud Dam of Orrisa, Journal of Environment & Pollution , Vol.5, Issue 2, pp. 157-160.

Saint Paul (1999) Minnesota Pollution Control Agency, Environmental Outcomes Division Ground Water Monitoring & Assessment Program MN 55155-4194 (651) 296-6300.

Sarala C. and Babu R. P. (2012); Assessment of Groundwater quality parameters in and around Jawahar Nagar, Hyderabad; *International Journals of Scientific and Research Publication, Vol,2* Issue *10* October 2012 1 ISSN 2250-3153.

Singh, S. K., Singh, C. K., Kumar, K. S., Gupta, R. & Mukherjee, S (2009) Spatialtemporal monitoring of groundwater using multivariate statistical techniques in Bareilly district of Uttar Pradesh, India. *J. Hydrol Hydrmcs* 57(1):45–54.

Subba Rao, N., Krishna Rao., G., (1991) "Intensity of Pollution of Groundwater in Visakhapatnam Area, A.P., India, Journal of Geological Society India., Vol. 36., pp. 670-673.

Subhadra Devi, D. G., Barbaddha, S. B., Hazel, D. and Dolly, C. (2003) Physico-chemical characteristics of drinking water at Velsao Goa. *J. Eco-Toxicol. Environ. Monitor.*, 13(3): 203-209.

Webster, N. S., Uthicke, S., Botte, E. S., Flores, F. and Negri, A. P. (2013) Ocean acidification reduces induction of coral settlement by crustose coralline algae. Global change Biology, 19: 303-315.

Table.1: Physico-Chemical Parameters of Water Samples of Chaka, Karchana and Kaundhiyara Blocks.

				PARAMETERS						
Sites	**pH**	**EC**	**TDS**	**Ca Hardness**	**Mg Hardness**	**Total Hardness**	**Alkalinity**	**Chloride**	**Sulphate**	**Nitrate**
C 1	8.13	0.7	370	254	354	608	380	110	501	8.2
C 2	8.05	0.6	324	182	416	599	355	75	469	9.63
C 3	8.01	0.4	301	171	377	548	375	104	945	9.17
C 4	7.95	0.9	440	220	415	635	435	105	703	8.92
C 5	7.92	0.7	416	198	365	563	503	105	817	6.09
C 6	8.11	0.4	235	171	362	534	373	65	753	9.41
C 7	7.89	0.5	292	151	505	657	361	89	612	8.78
C 8	8.33	0.6	311	102	544	646	498	160	764	8.12
C 9	8.06	0.8	436	172	632	804	511	105	456	8.83
C 10	8.02	0.6	351	114	496	611	530	95	755	6.74
K 1	8.52	0.4	235	156	392	548	355	45	383	9.9
K 2	7.96	0.4	246	129	400	529	356	35	421	8.45
K 3	8.05	0.6	372	205	398	603	455	110	315	7.43
K 4	8.03	0.5	307	210	383	593	445	60	419	8.52
K 5	7.85	0.7	371	210	346	556	481	114	664	6.66
K 6	8.25	0.5	284	192	339	532	408	140	765	8.95
K 7	7.96	0.8	431	232	357	589	448	115	687	8.15
K 8	8.02	0.6	319	194	369	563	380	100	708	8.82
K 9	7.82	0.7	365	198	376	575	413	104	648	9.38
K 10	7.85	0.6	332	203	352	556	420	80	601	6.49
KO 1	8.41	0.5	310	85	586	671	446	59	556	8.5
KO 2	8.37	0.7	397	96	542	638	461	110	713	10.67
KO 3	8.16	0.9	602	95	551	647	450	285	942	8.04
KO 4	7.98	0.8	752	72	506	579	643	210	783	8.63
KO 5	8.43	0.6	376	81	428	510	408	110	495	9.49
KO 6	8.14	0.7	430	83	548	634	491	94	643	8.05
KO 7	8.21	0.9	494	116	584	701	473	165	731	9.13
KO 8	8.29	0.6	380	74	547	621	395	109	114	7.09
KO 9	8.43	0.5	313	90	446	536	373	39	696	9.29
KO 10	8.36	0.5	308	70	456	527	376	70	473	8.12

All values are in mg/l, except pH, EC. Unit of EC are dSm^{-1}

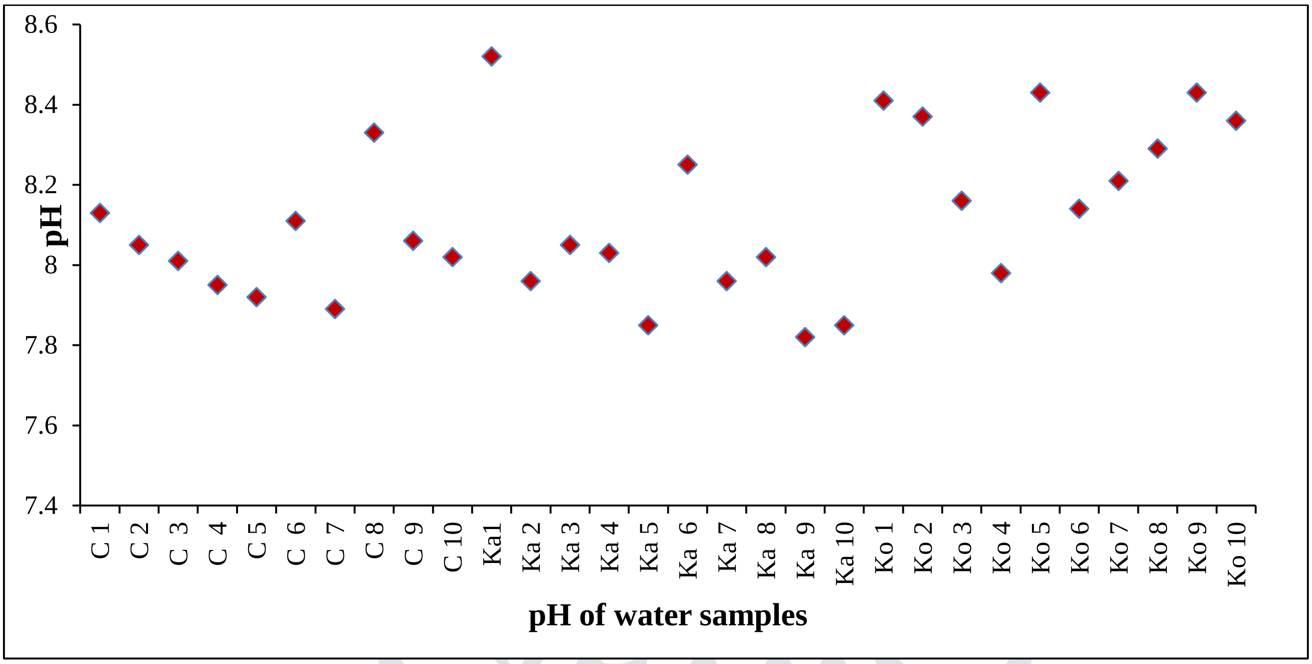

Fig 1: pH of water samples of Chaka, Karchana and Kaundhiyara Blocks

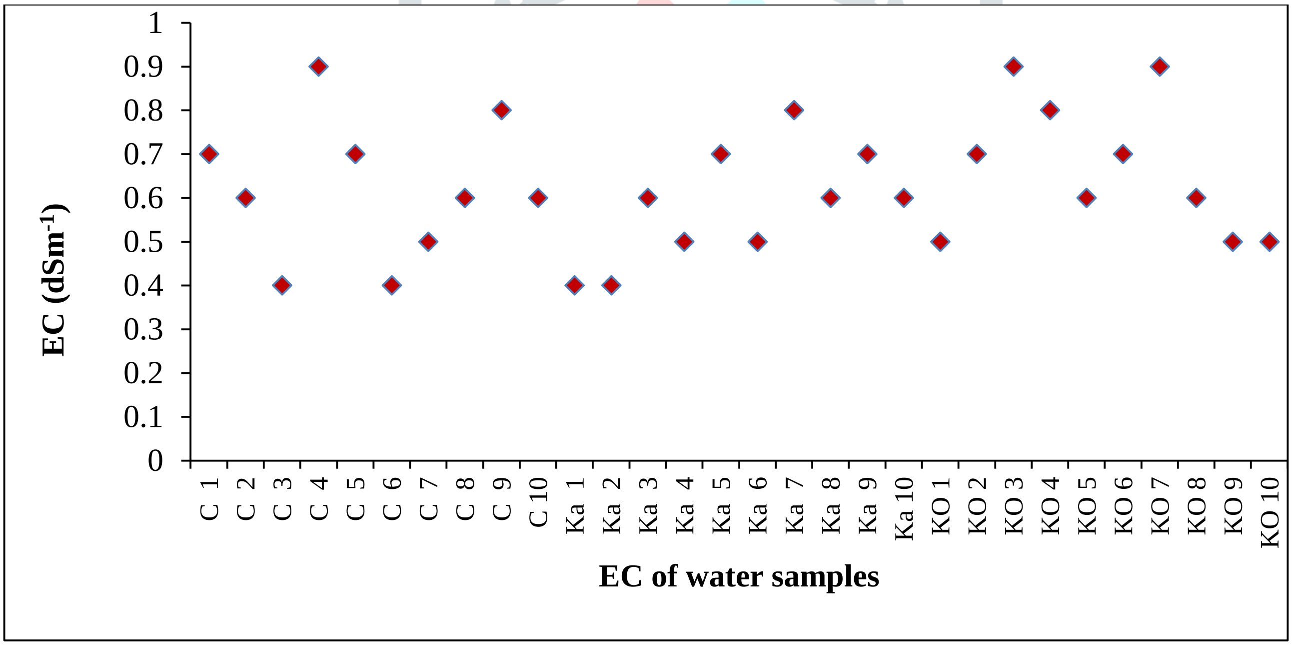

Fig 2: EC (dSm^{-1}) of water samples of Chaka, Karchana and Kaundhiyara Blocks

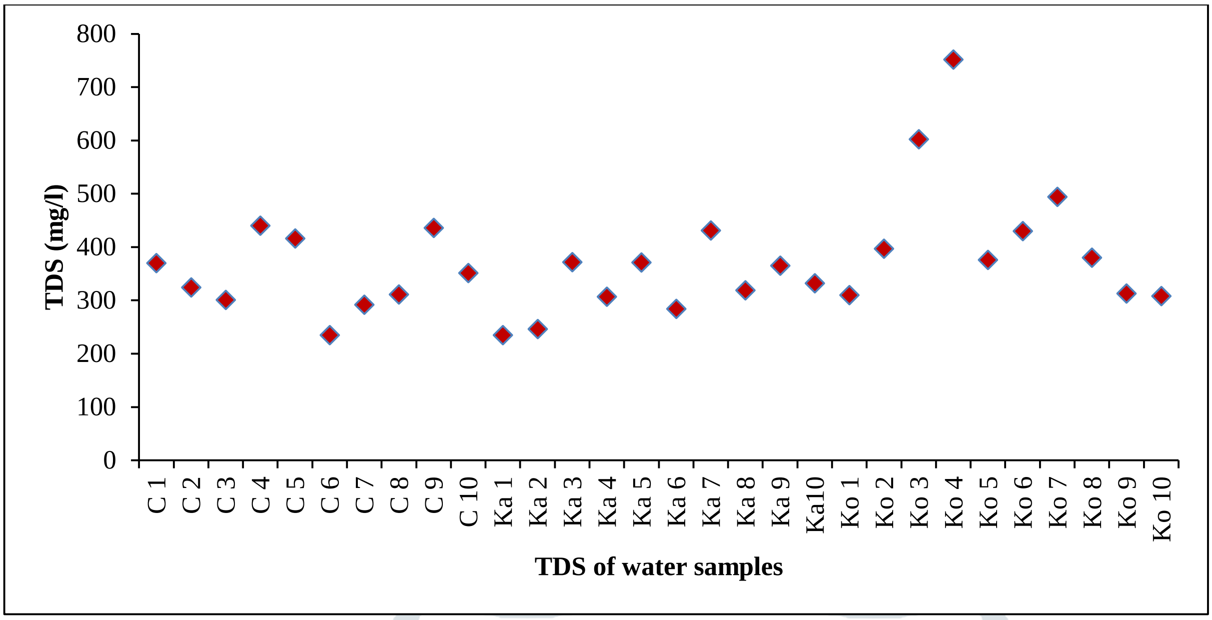

Fig 3: TDS (mg/l) of water samples of Chaka, Karchana and Kaundhiyara Blocks

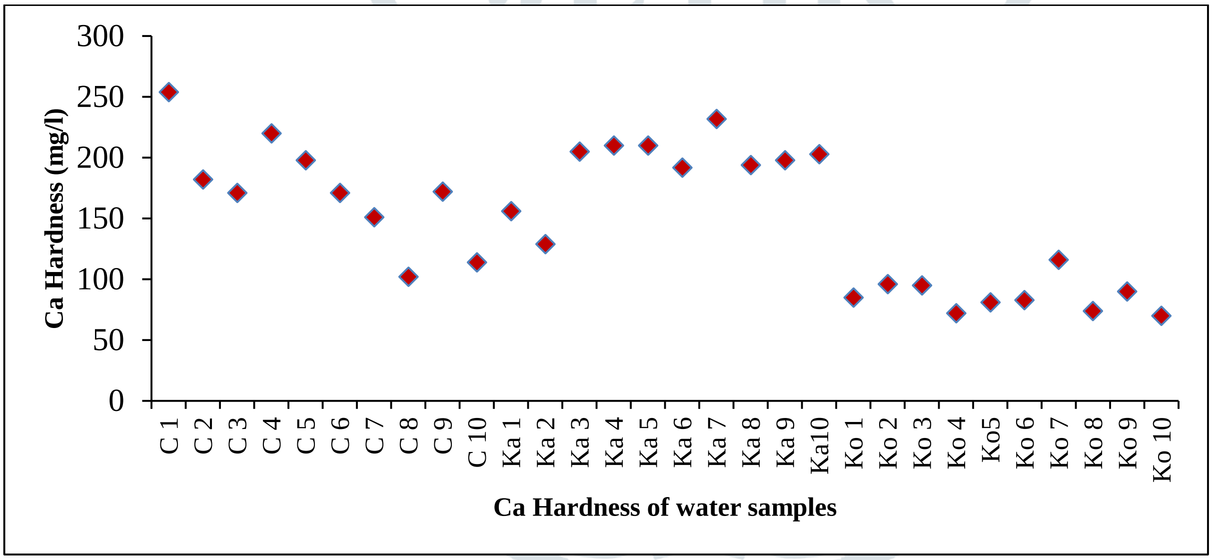

Fig 4: Calcium Hardness (mg/l) of water samples of Chaka, Karchana and Kaundhiyara Blocks

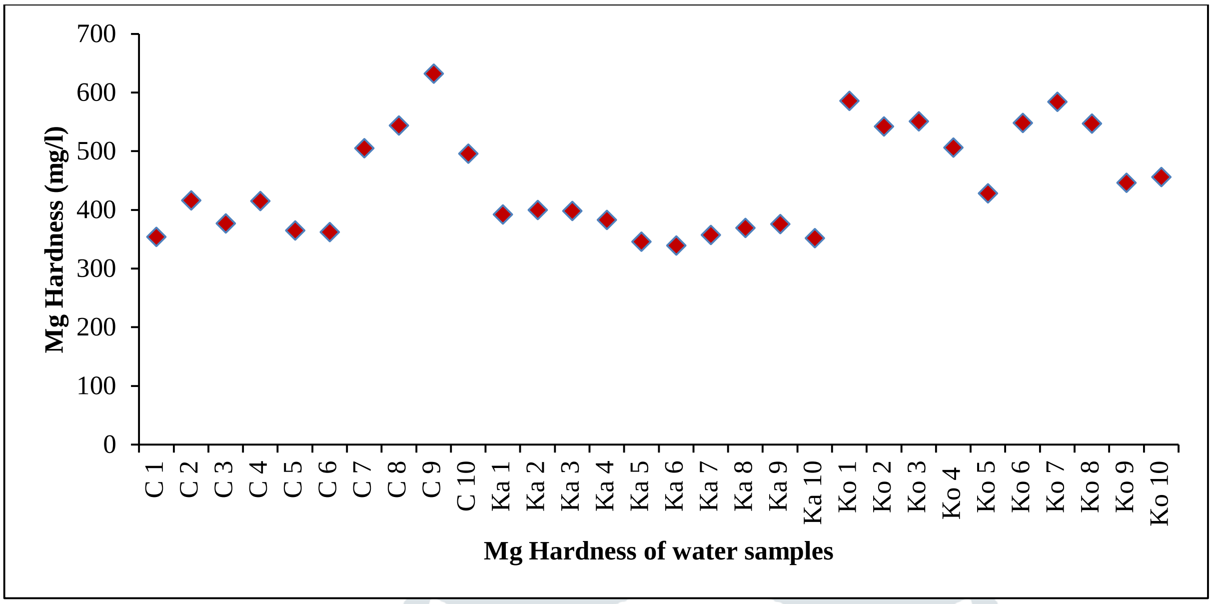

Fig 5: Magnesium Hardness (mg/l) of water samples of Chaka, Karchana and Kaundhiyara Blocks

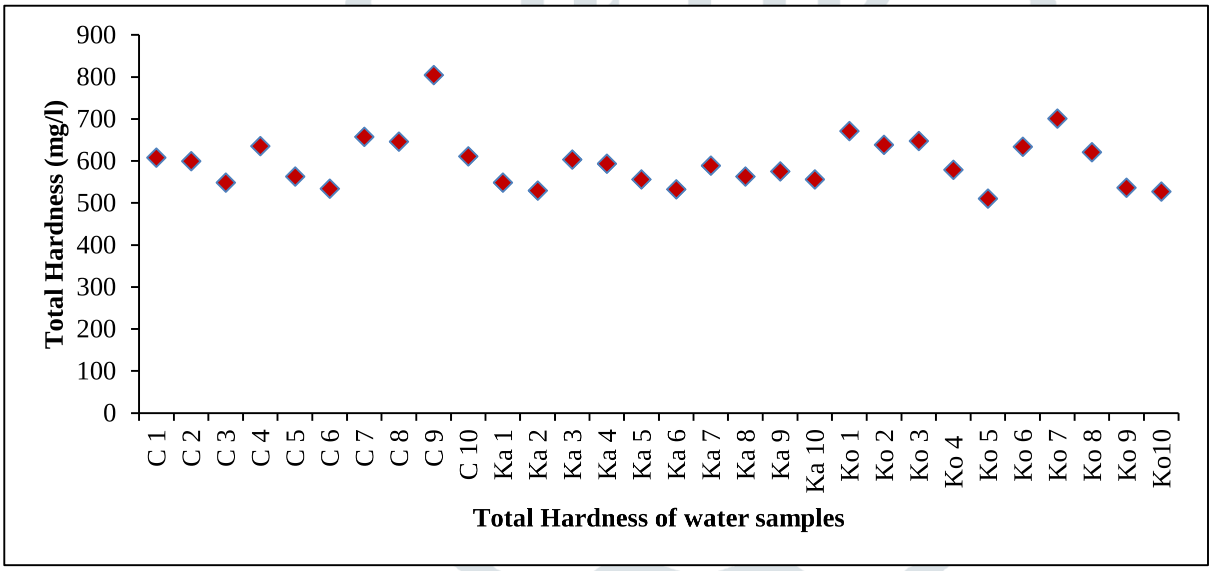

Fig 6: Total Hardness (mg/l) of water samples of Chaka, Karchana and Kaundhiyara Blocks

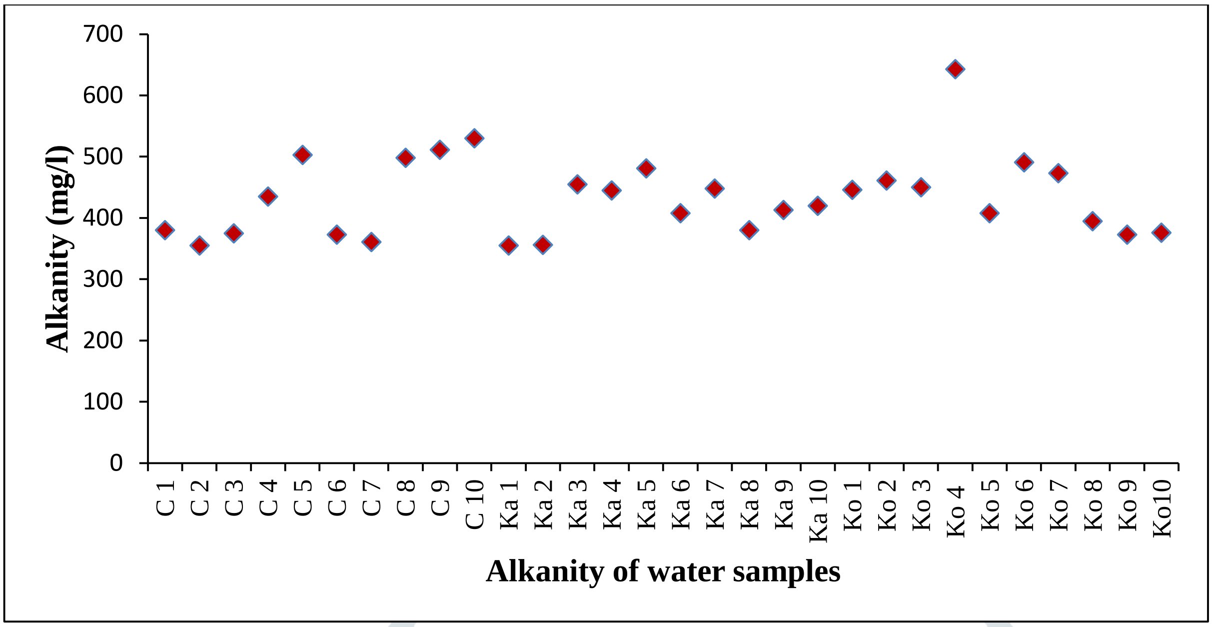

Fig 7: Alkalinity (mg/l) of water samples of Chaka, Karchana and Kaundhiyara Blocks

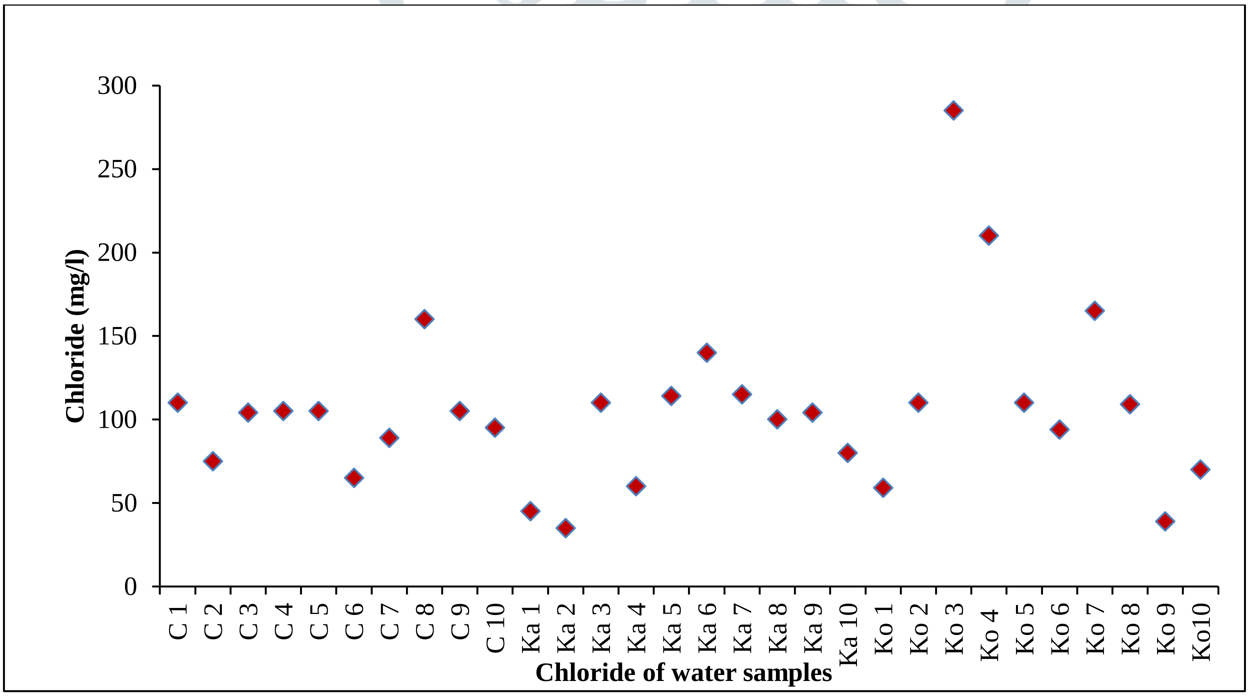

Fig 8 : Chloride (mg/l) of water samples of Chaka, Karchana and Kaundhiyara Blocks

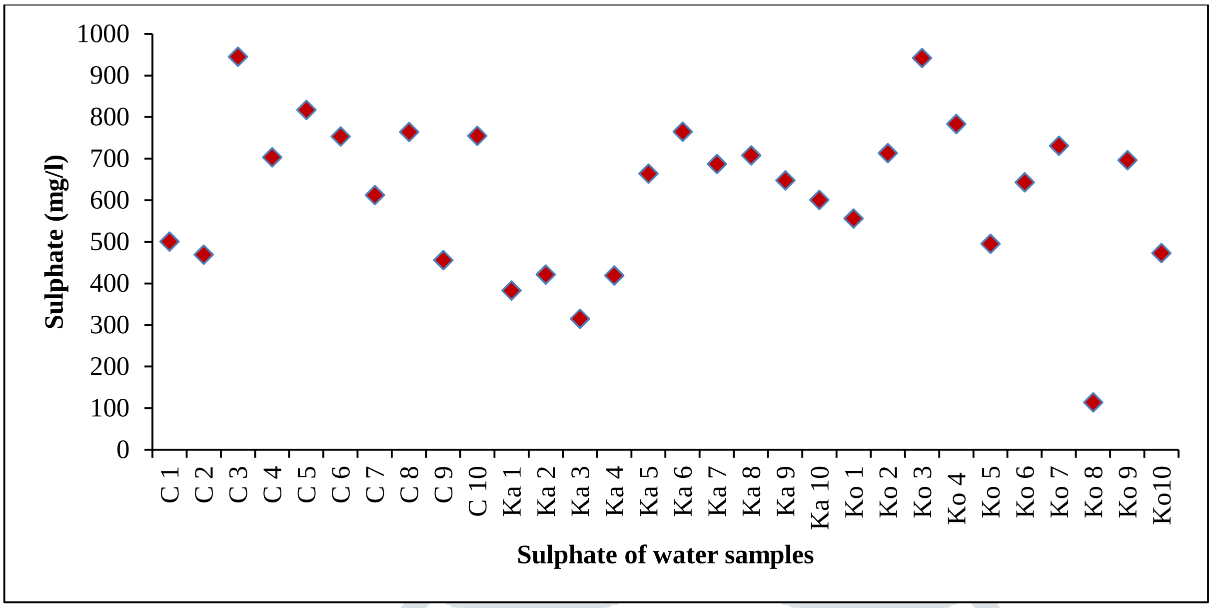

Fig 9 : Sulphate (mg/l) of water samples of Chaka, Karchana and Kaundhiyara Blocks

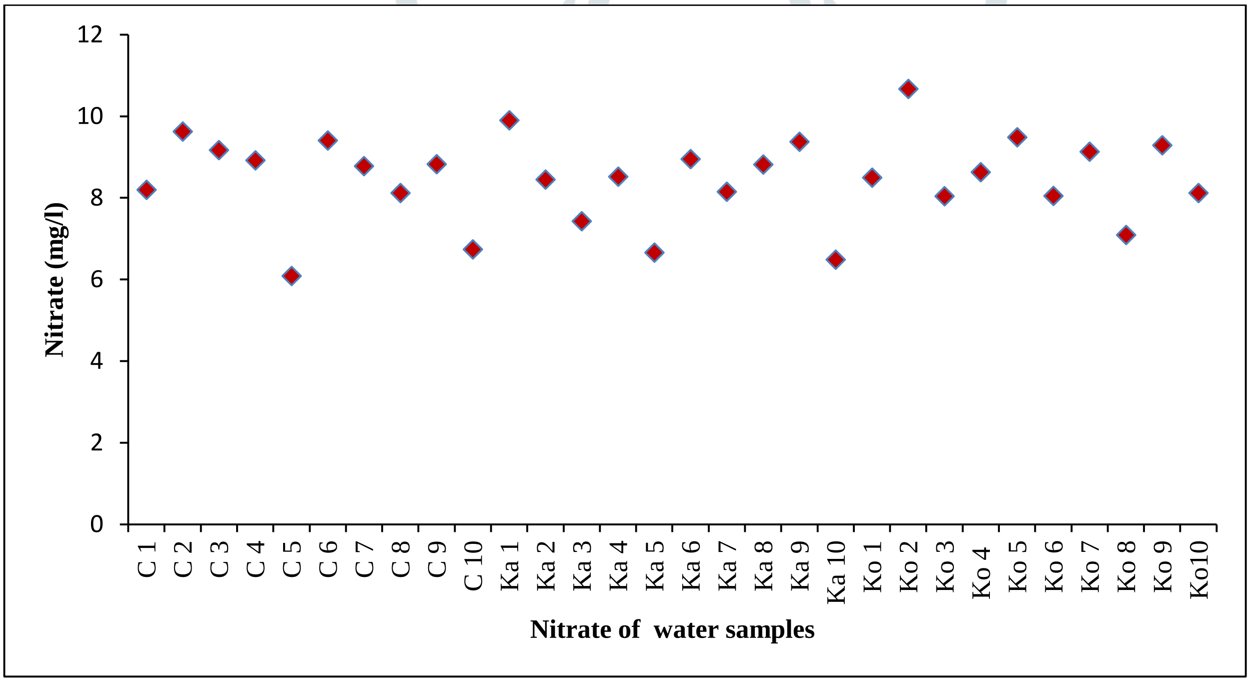

Fig 10: Nitrate (mg/l) of water samples of Chaka, Karchana and Kaundhiyara Blocks