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Mathematical Modelling Of Physicochemical Properties of Ground Water, Soil & Surfacewater in Rainy, summer & Winter Seasons Around Kota City

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Abstract
Salinityisoneofthemostbrutalenvironmentalfactorslimitingtheproductivity of crop plants because most of the crop plants are sensitive to salinity caused by high concentration accumulation of salts in the soil & the area of land affected by salinity & water logging. Its predictable here as the Rajasthan agricultural drainage research (RAJAD) project added by Canadian international development agency was introduced in 1992 to combat the problems of salinity and water logging in the Chambal command area(CCA), using horizontal sub surface drainage (SSD) technology as salinity may reduce by using some materialstoo.
As we know soil properties varies with different physiochemical parameters & soil degradation, erosion, leaching leads directly or indirectly water physiochemical properties.
Water in the soil is referred to as soil moisture & spaces between soil filed with water.
That's why to know physicochemical parameters we took the samples of ground water, soil and surface water in rainy, summer and winter Seasons from study areas Anta, Ladpura& Sultanpur Blocks affected by soil salinity & water logging.
Wefoundsometimesmaximum&sometimesminimumsignificantvariationinphysiochemical properties of samples collected in different season like rainy, summer and winter seasons. We found distinct variation in physiochemical parameters like Chloride, fluoride sodium, pH ions in ground water, soil and surface water in pre and postmonsoon.
Key Word: *Salinity; Chambal Command area; Physiochemical; Leaching;*

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I. Introduction

Soil is more important for the human being as they depend on it for food production,industrialwastedisposalaswellasculturalrequirement.(Versa, G Sudesh & Singh S.2013).

Abasiclifesupportcomponentofbiosphereandmediuminwhichcroppedgrowsfood&cloth for the world. It provides water, nutrients, oxygen for roots and moderated temperature (Jamieson et al.2002; vandermarrel,2004).

Soil degradation, erosion, leaching leads directly or indirectly water physicochemical properties (Dev, S Mahendra, 2012). Assessment of Physiochemical characteristics of the soil, MP India, 2014).

The physicochemical study & analysis of soil can improve soil productivity &minimize impacts and environmental leading to bias through optimal production.(Ku Smita Tale, Dr Sangita, Chem Sci Rev Lett,2015).

To know more we took the ground water, surface water & soil samples from the study area in different seasons like summer, rainy & winter (Chaurasiya AK Wani SP. Raghvendra S. Eastern 2013). We found sometime distinct variations in physiochemical parameters. (Solanki HA, ChavdaNH,2012), Brevic EC, Dickinson ND,2013. We found physiochemical properties variations in Ground Water, Soil & Surface Water (AdugnaAbegaz,Ethupia 2015), Hussain MA Sujaul IM, NaslyMalasiya 2013, Kumar LD Satish et al, 2015, Sharda AK 2013).

AlthoughthestudyareaAnta,Sultanpur&LadpurablocksarethepartsofChambalcommand area & affectedbysoilsalinity& waterlogging (Bhattacharyaet al,2015.Wefound minimum and sometime maximum too variations in physiochemical parameters in differentseasons). Even it varies in urban and sub-urban area.

Soil is a natural body (Ratanlal,2016). It neutrinos varies with pH, organic matters, contents (Cancelaetal,2006,StrahmandHarrison;2018)andaffectedbybiotic&abioticfactors(Peverillet al,1999), climate ,land form (S.Firdaus, S. Begam, A Yasmein,2016),(PS Minhas, RK Yadav,2015),(Singh, Raghuvanshi,2016).

ItisshowedclearvariationinpHvalueswithdifferentseasons(Lipika, Dipti, Isheta 2017). While very low variations in P,Na, Ktimes not significant in other physicochemical parameters (Ogundele et al, 2012). But one thing we found verycommon InallstudyareajustpostmonsoonPo4^{3-},So4^{2-},Cl^{-} wasestimatedhigherconcentrationbecause of leaching from agriculturalland.

II. STUDY AREA

ChambalcommandareafallsinKotadistrictlyinginbetweenlatitude25.2138° N and longitude 75.8648° E. The drainage of the area is controlled by the river Chambal, k

Kaalisindh& their tributaries. The study area Anta (25.1579° N, 76.3116° E), Sultanpur (26.2585° N, 82.0660° E) and Ladpura (25.1888° N, 75.8441° E), Blocks are the part of chambalcommandareaaffectedbysoilsalinity&waterloggingduetocontinueexcessive use of canal water having low topography relief and clay soil in larger. Ground water, surface eater & soil samples were collected & detected physicochemical parameters in summer, rainy &winter. In order to simplify sampling sites of these three blocks and surrounding area of CCA around kota city is described & signified as zone A, zone B & zone C for view of studies.

Zone A : Anta		**Zone B : Ladpura**		**Zone C : Sultanpur**
Sub urban & Industrial Area having good plantation		Urban area, high traffic pollution with industrial area.		Sub urban & rural area having good plantation

These study areas are shown in table I & figure I.

Table no 3.1 Ground Water, Soil & Surface Water quality monitoring stations at the study areas.

Station	Station Locations	Lattitude	Logitude
Zone A	Anta & Surrounding area	25.1579° N,	76.3116° E
Zone B	Ladpura& Surrounding area	25.1888° N,	75.8441° E
Zone C	Sultanpur & Surrounding area	26.2585° N,	82.0660° E

Figure 3.1. Location of three selected zones or stations aroundKota city.

III. Methodology

Groundwater,surfacewaterandsoilsamplesinsummerrainy&winterseasonswerecollected fromselectedareastostudy.Soilsamplesairdriedandsievetoremovetheunwantedparticles. A paste of soil & water was stirred to make homogeneous slurry and then allowed to stand for at least 2-4 hours then leached amount was taken as sample.27 samples weredetected.

The pH was determine by the pH meter turbidity by turbidity measurements, TDS by TDS meter, electrical conductance by electrical conductivity meter, total hardness Ca^{2+}, Mg^{2+}, Cl^{-}, DO, $CO3^{-2}$, Bicarbonate were detected by simple titrimetric method while $NO3^{-}$, $SO4^{-2}$ and Fe^{2+}were determine by Spectro photometer and fluoride by photometer.

After detection of physicochemical parameters and comparative studies of ground water, surfaceareaandsoilsampleswefounddifferentvariationsinparametersduringsummer,rainy & winterseasons.

Physicochemical parameters variations of ground water, soil & surface water in rainy,summer & winter seasons around kotacity

- **For pH**

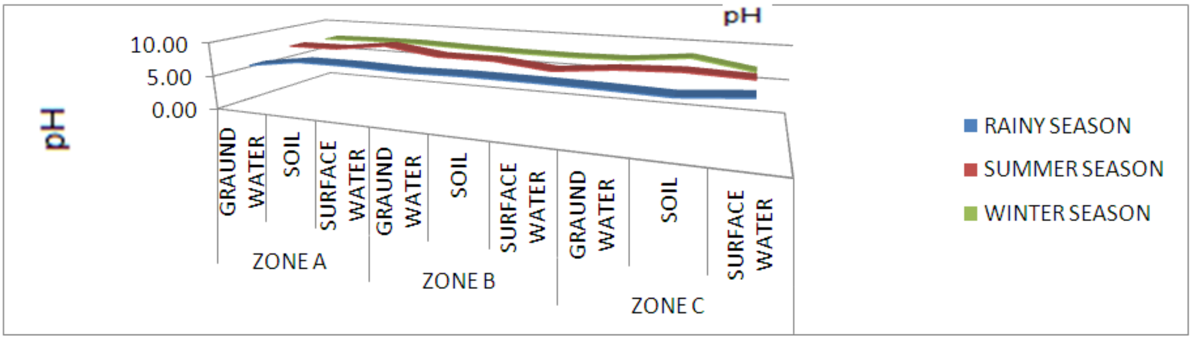

Figure 6.1

For DO(Mg/l)

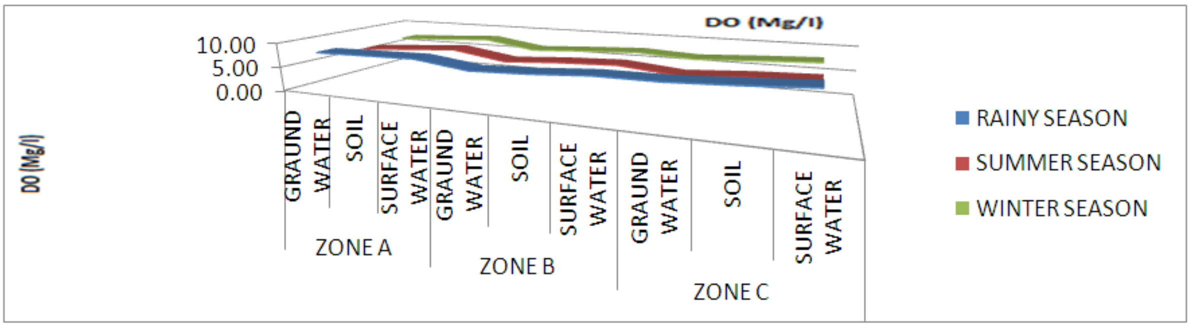

Figure 6.2

- **For EC(μs)**

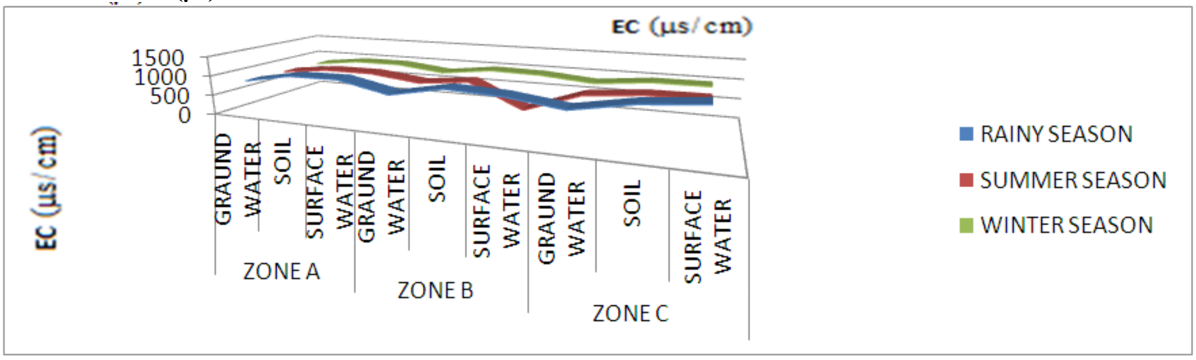

Figure 6.3

- **For TH (mg/l)**

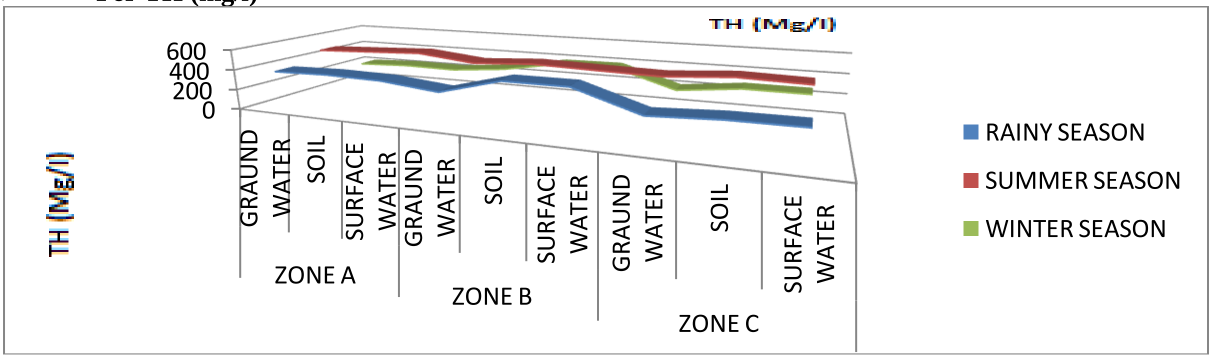

Figure 6.4

- **For TDS(mg/l)**

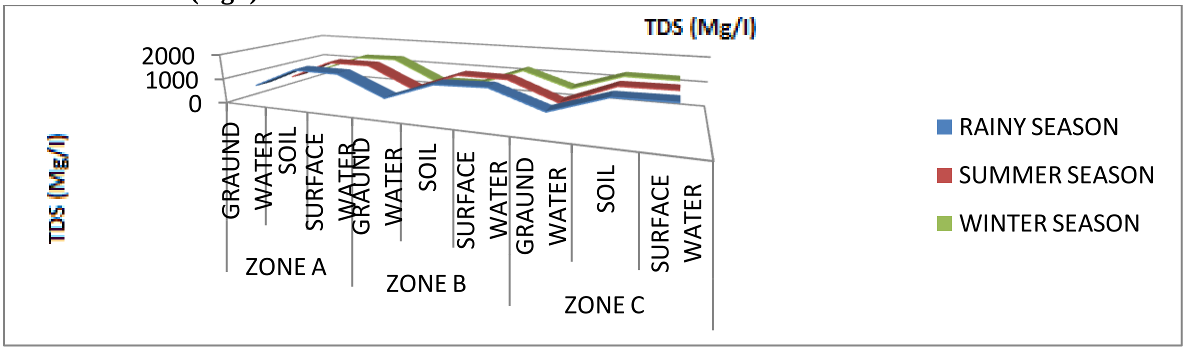

Figure 6.5

- **For TURBIDITY(NTU)**

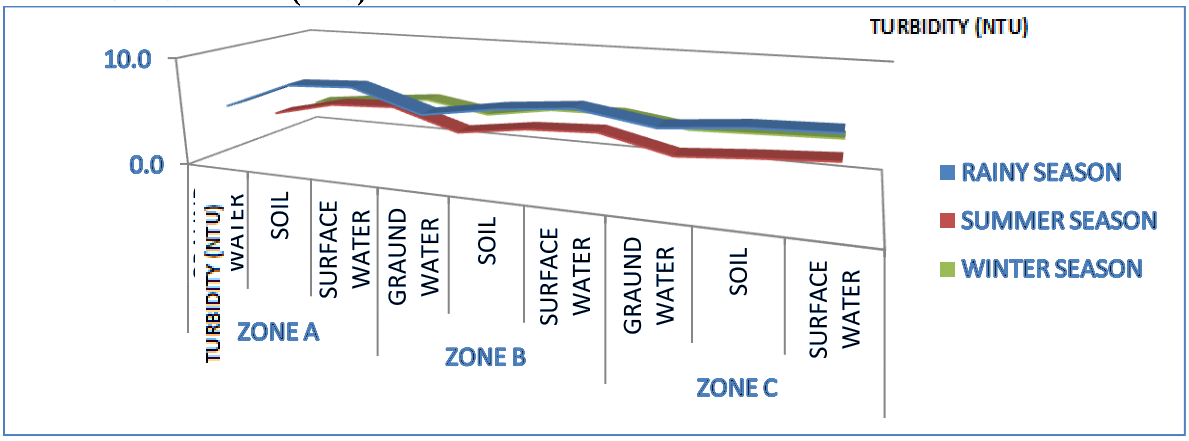

Figure 6.6

- **ForFe^{2+} (mg/l)**

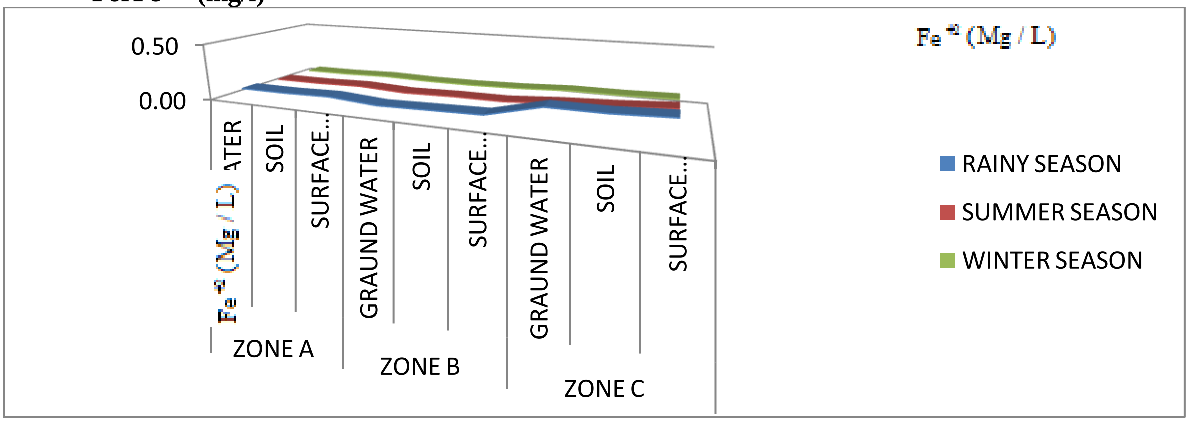

Figure 6.7

➢ **For K^{+} (mg/l)**

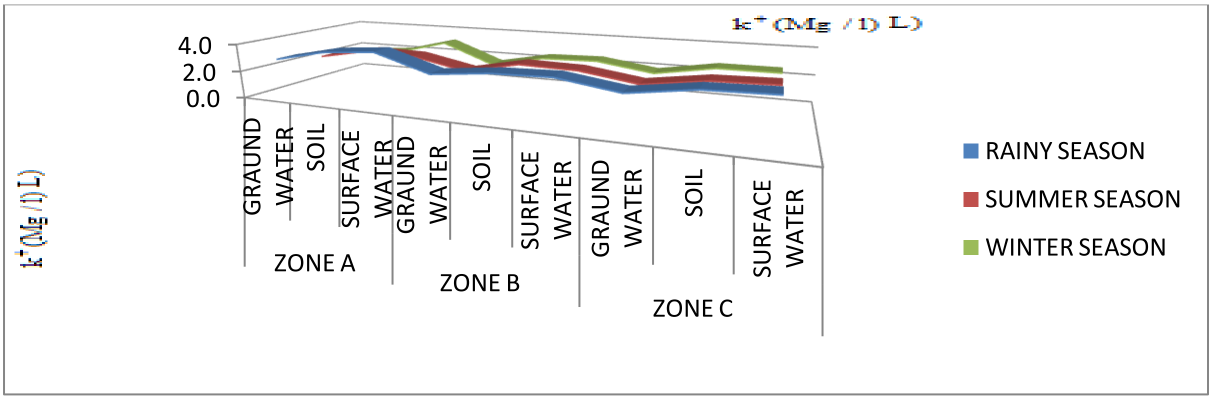

Figure 6.8

➢ **For F^{-}(mg/l)**

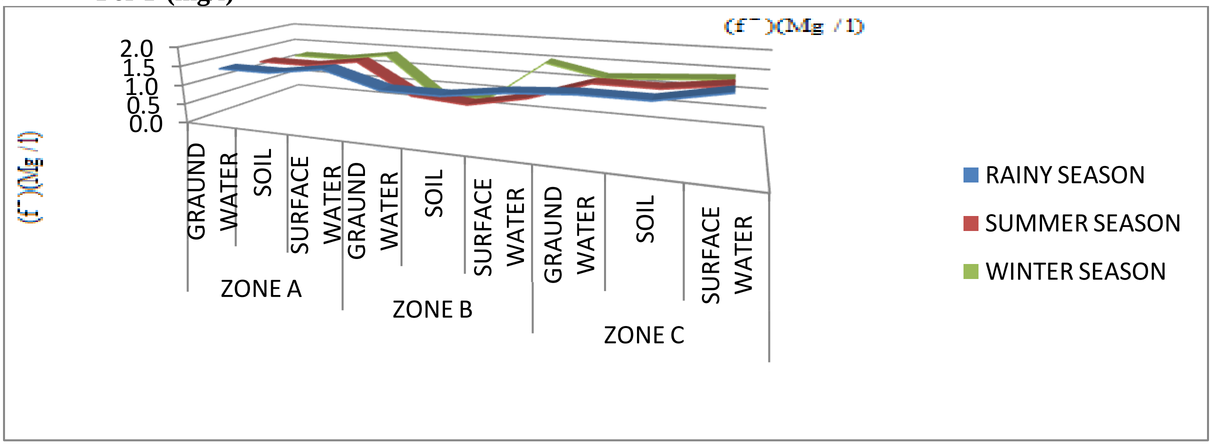

Figure 6.9

➢ **For $SO4^{2-}$ (mg/l)**

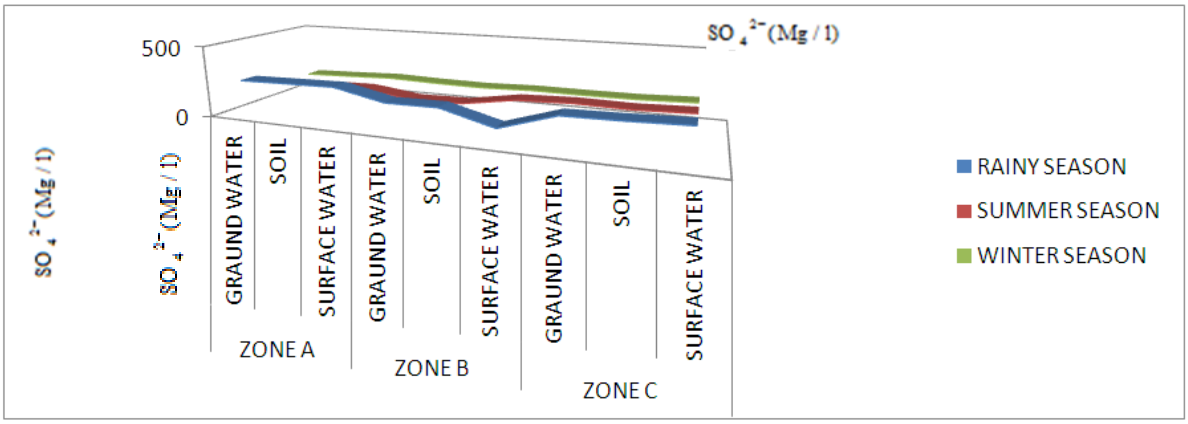

Figure 6.10

➢ **For $PO4^{3-}$(mg/l)**

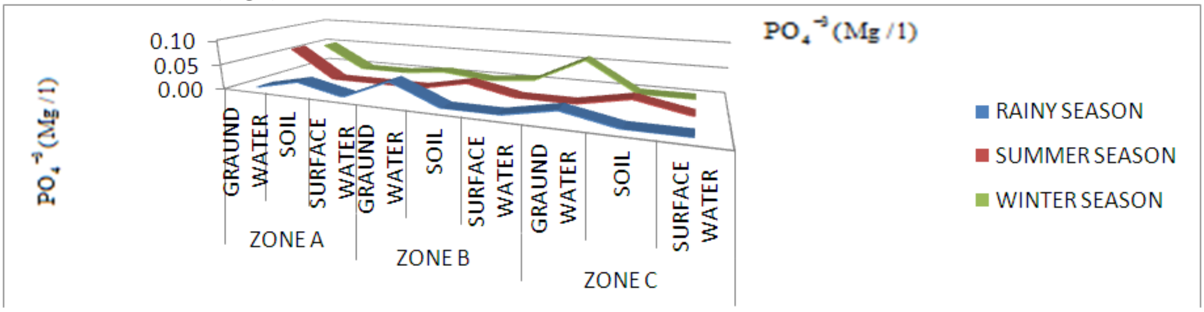

Figure 6.11

6. Statistical Analysis of Physiochemical parameters of all the 3 zonesare carried out annually in reference of various samples ofGround Water, Surface Water annually.

Descriptive statistical parameters likeMean, Standard Deviation, Root Mean Square &Their mutually correlation were determined in order to differences& mutually relations between different categories, statistical parameters of these parameters of different samples during different time period are listed in following tables & figures:

7.Afor Ca^{2+} Concentration

Statistical analysis of Ca^{2+} concentration in Zone A, Zone B &Zone C in the reference of three types of samples including seasonal changes

Table 7.A.1 Seasonal variation in the concentration of Ca^{2+} (mg/l)

		ZONE A			ZONE B			ZONE C			
		GROUND WATER	SOIL	SURFACE WATER	GROUND WATER	SOIL	SURFACE WATER	GROUND WATER	SOIL	SURFACE WATER	CORREL WITH MEAN
RAINY	July Ist Week	148	118	173	136	107	154	126	80	97	0.50
	July IInd Week	42	179	52	141	122	117	131	137	125	-0.14
	July IIIrd Week	172	43	136	175	152	79	103	109	113	-0.18
	July IVth Week	119	108	194	116	146	188	74	131	169	0.59
	Aug Ist Week	128	143	61	68	171	150	161	168	159	-0.37
	Aug IInd Week	106	155	141	100	113	174	93	98	84	0.79
	Aug IIIrd Week	72	123	154	98	95	128	86	92	140	0.59
	Aug IVth Week	168	158	139	124	184	96	149	155	102	-0.01
SUMMER	April IIIrd Week	148	168	169	162	174	132	122	153	148	0.61
	April IVth Week	163	153	188	168	139	150	93	67	128	0.76
	May Ist Week	116	189	93	76	82	126	96	125	108	0.29
	May IInd Week	172	66	189	133	163	176	142	148	78	0.10
	May IIIrd Week	112	169	176	108	117	153	147	179	136	0.17
	May IVth Week	153	82	58	137	168	103	153	102	111	-0.51
	June Ist Week	83	197	201	106	113	93	60	129	157	0.63
	June IInd Week	141	202	147	156	144	183	119	99	161	0.71
WINTER	Dec Ist Week	131	91	203	96	118	150	139	128	63	0.27
	Dec IInd Week	158	67	112	110	153	146	120	59	105	0.13
	Dec IIIrd Week	106	103	166	192	148	78	130	134	143	-0.13

	Dec IVth Week	142	163	92	145	73	119	128	103	53	0.04
	Jan Ist Week	67	133	72	153	104	158	53	59	148	0.39
	Jan IInd Week	77	187	87	57	142	107	82	127	92	0.41
	Jan IIIrd Week	116	83	176	68	159	163	43	50	151	0.68
	Jan IVth Week	134	197	132	133	66	68	96	145	135	0.09
	MEAN	123.92	136.54	137.96	123.25	131.38	132.96	110.25	115.71	121.08	
	STD DEV	35.82	47.32	48.53	35.88	32.91	34.70	32.88	35.56	32.24	
	MEAN SQUARE	15355.34	18643.63	19032.50	15190.56	17259.39	17677.92	12155.06	13388.42	14661.17	
	SQUARE ROOT	11.13	11.69	11.75	11.10	11.46	11.53	10.50	10.76	11.00	
	RMS	126.21									

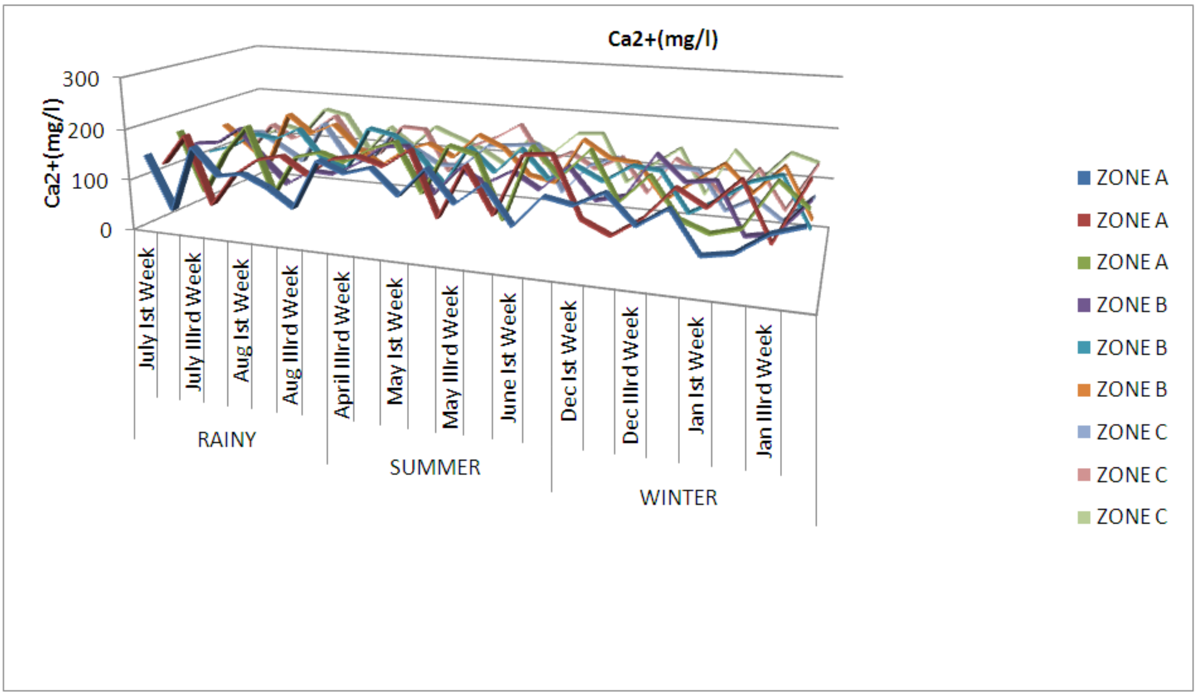

Figure 7.A.1

Figure 7.A.1.Shows the graphical representation of annuallyvariations of Ca^{2+} concentration for Zone A, Zone B & Zone C of three types of samples including seasonal changes.

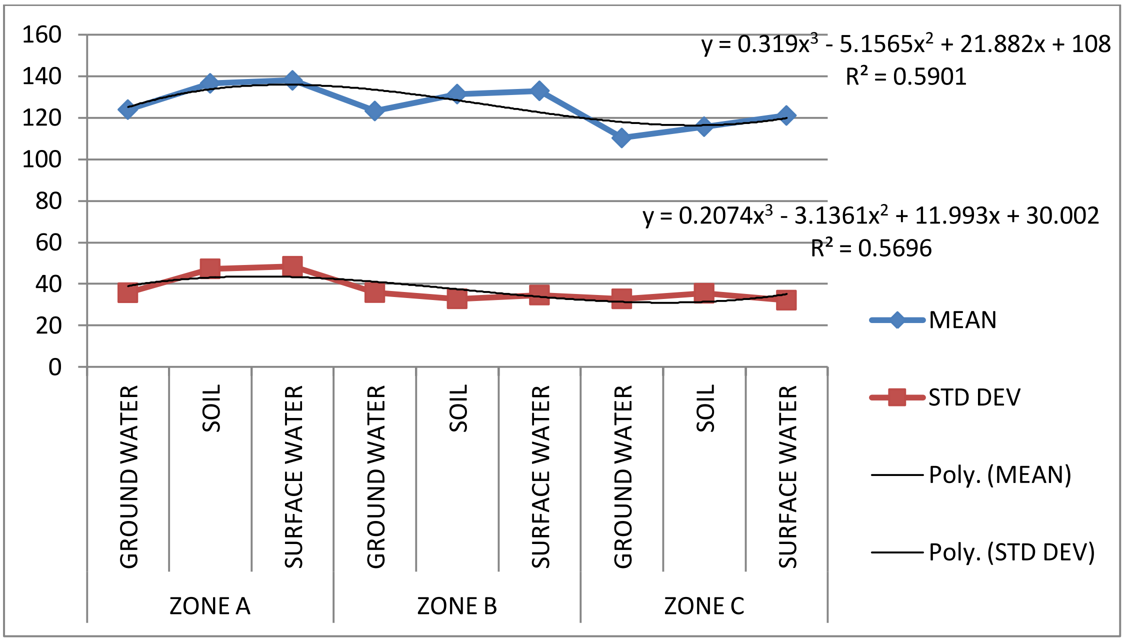

Figure7.A.1.1

Figure 7.A.1.1.Shows the graphical representation of mutually correlation of all the statistical parameters &Ca^{2+} concentration.

7.B For Cl^-concentration

Statistical analysis of Cl^- concentration in Zone A, Zone B &Zone C in the reference of three types of samples including seasonal changes.

Table 7.B.1

		ZONE A			ZONE B			ZONE C			
		GROUND WATER	SOIL	SURFACE WATER	GROUND WATER	SOIL	SURFACE WATER	GROUND WATER	SOIL	SURFACE WATER	CORREL WITH MEAN
RAINY	July Ist Week	397	96	401	221	261	287	210	269	300	0.13
	July IInd Week	92	426	356	284	307	105	166	417	284	0.35
	July IIIrd Week	206	416	102	306	37	349	387	411	101	-0.36
	July IVth Week	180	276	290	416	411	408	96	100	38	0.28
	Aug Ist Week	225	407	301	391	272	402	409	257	299	-0.22
	Aug IInd Week	280	42	298	99	422	41	302	301	397	0.00
	Aug IIIrd Week	310	301	51	200	419	299	282	33	402	0.07
	Aug IVth Week	412	266	399	186	104	302	217	406	341	0.16
SUMMER	April IIIrd Week	113	261	186	409	419	216	192	415	411	0.18
	April IVth Week	66	358	89	248	191	197	106	85	355	0.29
	May Ist Week	200	68	201	376	88	93	63	189	179	-0.31
	May IInd Week	130	205	210	181	193	182	371	358	193	-0.36
	May IIIrd Week	403	200	418	136	211	82	173	253	213	0.07
	May IVth Week	253	83	268	196	61	358	131	57	89	0.04
	June Ist Week	371	194	362	71	363	272	403	189	78	-0.07

	June IInd Week	187	415	74	109	257	411	242	186	267	0.37
WINTER	**Dec Ist Week**	210	189	42	282	25	68	199	190	200	-0.70
	Dec IInd Week	44	347	231	101	300	187	146	22	67	0.46
	Dec IIIrd Week	143	97	303	78	292	358	322	338	307	0.31
	Dec IVth Week	168	187	210	328	65	96	99	297	185	-0.21
	Jan Ist Week	323	33	62	163	181	48	278	101	258	-0.61
	Jan IInd Week	83	252	193	149	103	261	76	290	356	0.57
	Jan IIIrd Week	197	301	352	52	341	309	161	180	44	0.60
	Jan IVth Week	278	57	102	201	193	202	50	59	92	-0.01
	MEAN	219.63	228.21	229.21	215.96	229.83	230.54	211.71	225.13	227.33	
	STD DEV	108.99	128.10	121.39	111.55	129.12	121.35	111.06	128.79	121.30	
	MEAN SQUARE	48235.14	52079.04	52536.46	46638.00	52823.36	53149.46	44820.42	50681.27	51680.44	
	SQUARE ROOT	14.82	15.11	15.14	14.70	15.16	15.18	14.55	15.00	15.08	
	RMS	224.26									

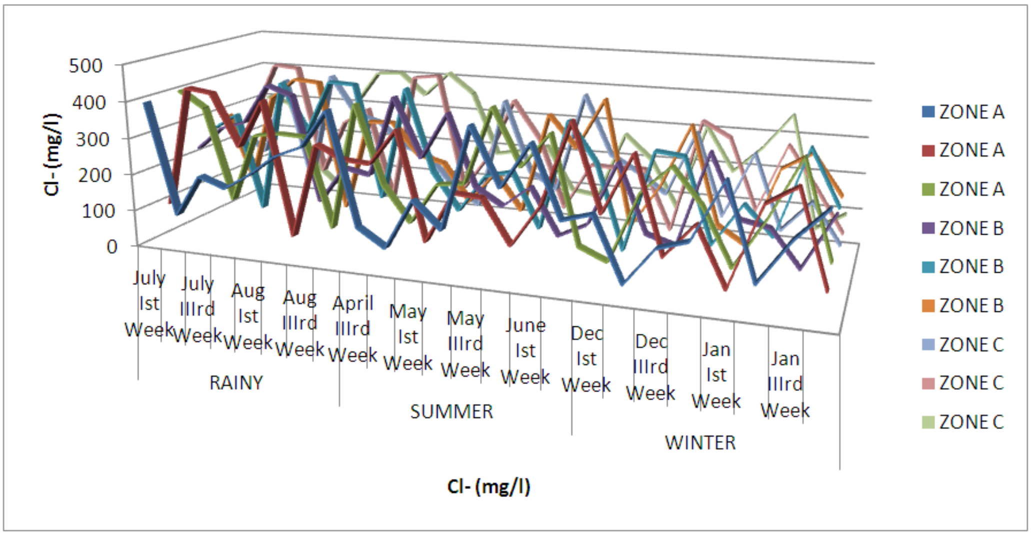

Figure 7.B.1

Figure 7.B.1.Shows the graphical representation of annually variations of Cl^- concentration for Zone A, Zone B & Zone C of three types of samples including seasonal changes.

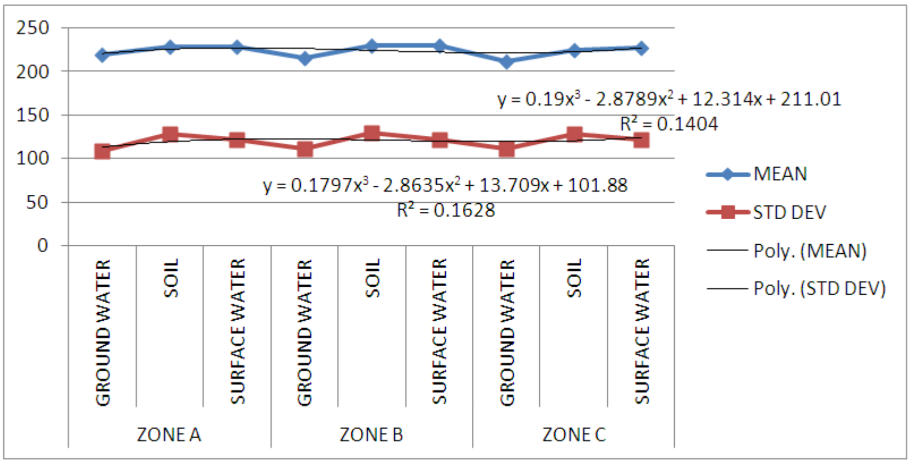

Figure 7.B.1.1.

Figure 7. B.1.1. Shows the graphical representation of mutually correlation of all the statistical parameters &Cl^- concentration.

7.C For Mg^{2+}Concentration

Statistical analysis of Mg^{2+} concentration in Zone A, Zone B &Zone C in the reference of three types of samples including seasonal changes: -

Table- 7.C.1

		ZONE A			ZONE B			ZONE C			
		GROUND WATER	SOIL	SURFACE WATER	GROUND WATER	SOIL	SURFACE WATER	GROUND WATER	SOIL	SURFACE WATER	CORREL WITH MEAN
RAINY	July Ist Week	26.44	62.21	27.14	72.18	74.86	83.27	40.89	40.82	50.07	0.6496
	July IInd Week	87.15	55.57	97.22	40.89	53.48	41.48	83.55	65.44	84.12	-0.4771
	July IIIrd Week	50.12	75.88	69.72	90.83	54.89	48.46	58.42	42.22	68.11	-0.2020
	July IVth Week	49.27	60.4	39.37	60.71	64.22	64.67	27.68	52.67	59.16	0.6570
	Aug Ist Week	57.48	65.27	61.22	54.24	81	63.22	69.81	58.16	61.35	0.4837
	Aug IInd Week	61.92	82.18	85.19	59.42	76.38	48.23	55.15	75.67	33.66	0.1117
	Aug IIIrd Week	55.23	45.47	53.67	28.92	46.34	78.55	78.26	74.43	41.65	0.0153
	Aug IVth Week	65.48	37.34	57.83	69.72	66.82	80.22	33.46	61.67	77.8	0.4451
SUMMER	April IIIrd Week	62.21	68.4	70.2	63.58	66.2	71.5	58.68	60.18	61.42	0.7751
	April IVth Week	51.1	60.12	78.77	47.56	60.12	82.53	42.61	71.18	77	0.6106
	May Ist Week	59.98	72.77	97.84	71.34	78.41	63.87	60.16	62.24	45.12	0.2920
	May IInd Week	81.87	83.58	72.49	86.09	82.48	60.06	31.37	66.41	33.76	0.2549
	May IIIrd Week	74.13	98.77	83.29	40.52	84.57	92.24	52.54	54.72	69.7	0.7300
	May IVth Week	86.19	50.16	62.16	79.53	60.47	81.46	81.82	42.16	54.14	-0.1699
	June Ist Week	36.61	90.4	60.72	65.77	50.66	71.87	74.82	49.22	89.23	0.0662
	June IInd Week	44.36	20.22	40.16	55.88	67.82	46.52	66.16	78.62	52.16	-0.1732
WINTER	Dec Ist Week	56	58.82	54.82	57.62	76	68.42	54.48	59.23	60.12	0.8513
	Dec IInd Week	69.7	68.13	60.64	33.34	67.23	47.22	76.48	34.72	37.72	-0.0297
	Dec IIIrd Week	43.32	62.18	79.19	90.14	95.82	61.32	55.83	60.72	72.55	0.3939
	Dec IVth Week	42.22	77.16	70	22.16	70.78	52.68	85.36	78.82	42.87	0.0584
	Jan Ist Week	70.22	40.42	53.94	73.77	85.44	75.17	67.27	69.07	83.16	0.1831
	Jan IInd Week	37.68	49.48	29.26	81.13	58.46	69.02	32.67	84.54	78.34	0.1770
	Jan IIIrd Week	73.71	81.58	38.14	43.61	39.4	84.44	41.42	40.6	68.82	0.2867
	Jan IVth Week	60.26	33.62	48.06	22.16	49.53	89.41	23.88	49.02	63.72	0.6151
	MEAN	58.44	62.51	62.13	58.80	67.14	67.74	56.37	59.69	61.07	
	STD DEV	15.90	18.98	19.38	20.54	14.07	14.81	18.80	13.80	16.45	
	MEAN SQUARE	3415.67	3906.93	3859.72	3457.00	4507.89	4589.10	3177.06	3562.75	3729.90	
	SQUARE ROOT	7.64	7.91	7.88	7.67	8.19	8.23	7.51	7.73	7.81	
	RMS	61.64956811									

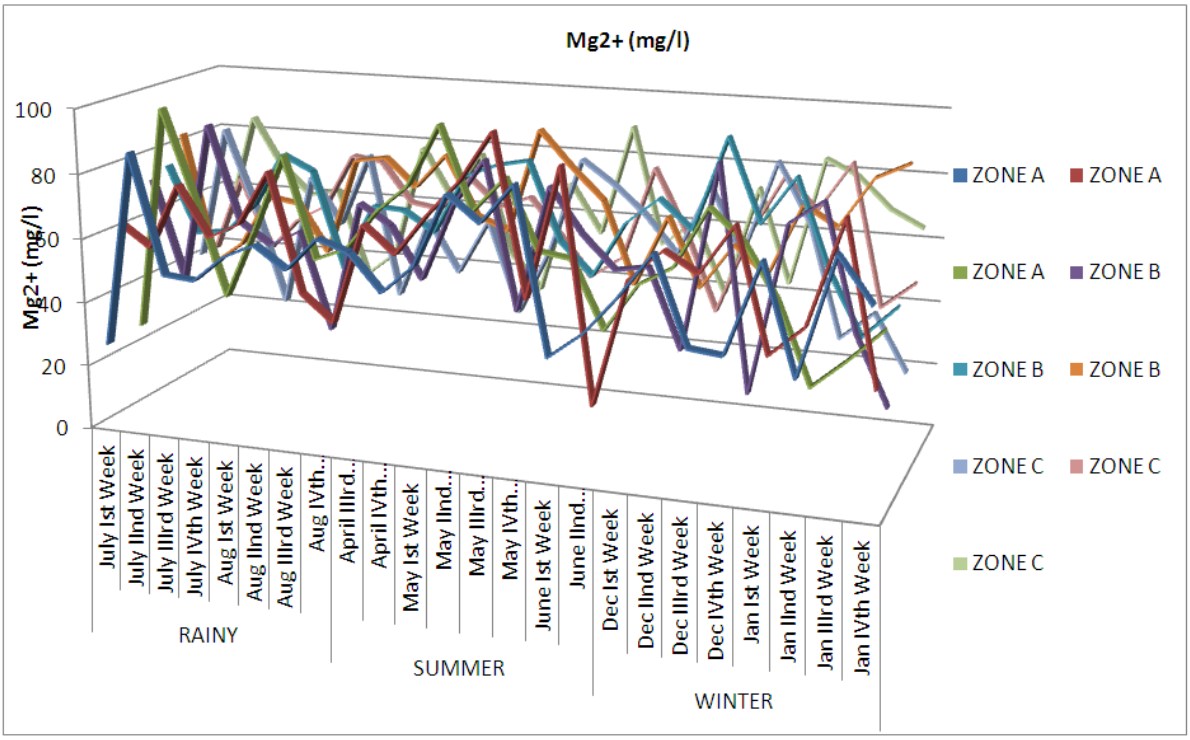

Figure 7.C.1

Figure 7.C.1. Shows the graphical representation of annually variations of Cl^- concentration for Zone A, Zone B & Zone C of three types of samples including seasonal changes.

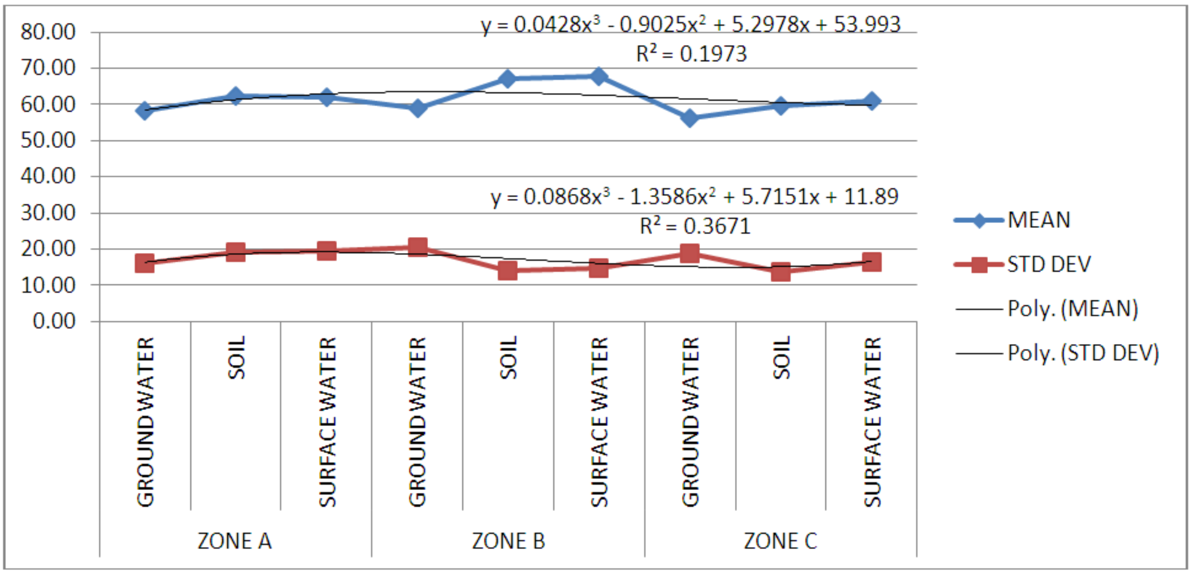

Figure 7.C.1.1.

Figure 7.C.1.1.Shows the graphical representation of mutually correlation of all the statistical parameters &Mg^{2+} concentration.

7.D For NO_3^- concentration

Statistical analysis of NO_3^- concentration in Zone A, Zone B &Zone C in the reference of three types of samples including seasonal changes

Table 7.D.1.

		ZONE A			ZONE B			ZONE C			
		GROUND WATER	SOIL	SURFACE WATER	GROUND WATER	SOIL	SURFACE WATER	GROUND WATER	SOIL	SURFACE WATER	CORREL
RAINY	July Ist Week	11.5	65	56	39	63	12.5	41	45	46	0.54
	July IInd Week	64	51	28	26	28	38	66	67	48	-0.21
	July IIIrd Week	38	40	42	16	18	52	25	30	68	-0.17
	July IVth Week	43	29	24	47	46	40	57	37	22	-0.03
	Aug Ist Week	28	35	49	12	33	27	41	23	35	0.13
	Aug IInd Week	39	46	51	54	37	60	15	58	63	-0.08
	Aug IIIrd Week	33	35	63	66	14	42	20	54	26	0.19
	Aug IVth Week	48	26	18	24	37	34	62	46	56	0.01
SUMMER	April IIIrd Week	32	34	35	28	34	35	40	46	48	0.23
	April IVth Week	63	58	50	44	15	56	29	24	35	-0.43
	May Ist Week	31	49	57	38	65	36	14	62	38	-0.10
	May IInd Week	34	63	39	59	22	31	28	42	20	0.13
	May IIIrd Week	41	60	60	11	17	14	65	69	55	0.25
	May IVth Week	19	34	22	20	46	39	51	34	41	0.17
	June Ist Week	56	39	40	16	19	24	62	58	64	0.08
	June IInd Week	38	48	39	21	53	46	42	29	32	-0.44
WINTER	Dec Ist Week	28	32	25	24	38	28	38	42	40	0.15
	Dec IInd Week	41	17	52	52	28	61	33	58	14	-0.22
	Dec IIIrd Week	13	47	19	15	19	22	37	40	68	0.37
	Dec IVth Week	37	11	12	11	27	41	36	65	44	-0.27
	Jan Ist Week	28	11.5	46	20	14	14	62	29	26	0.44
	Jan IInd Week	18	52	13	42	36	24	15	56	58	0.22
	Jan IIIrd Week	26	30	30	17	12	33	49	18	60	0.32
	Jan IVth Week	20	55	60	22	39	12	44	26	24	0.37
	MEAN	34.56	40.31	38.75	30.17	31.67	34.23	40.50	44.08	42.96	
	STD DEV	13.94	15.30	15.93	16.47	15.16	14.35	16.36	15.35	16.17	
	MEAN SQUARE	1194.57	1625.10	1501.56	910.03	1002.78	1171.64	1640.25	1943.34	1845.42	
	SQUARE ROOT	5.88	6.35	6.22	5.49	5.63	5.85	6.36	6.64	6.55	
	RMS	37.76									

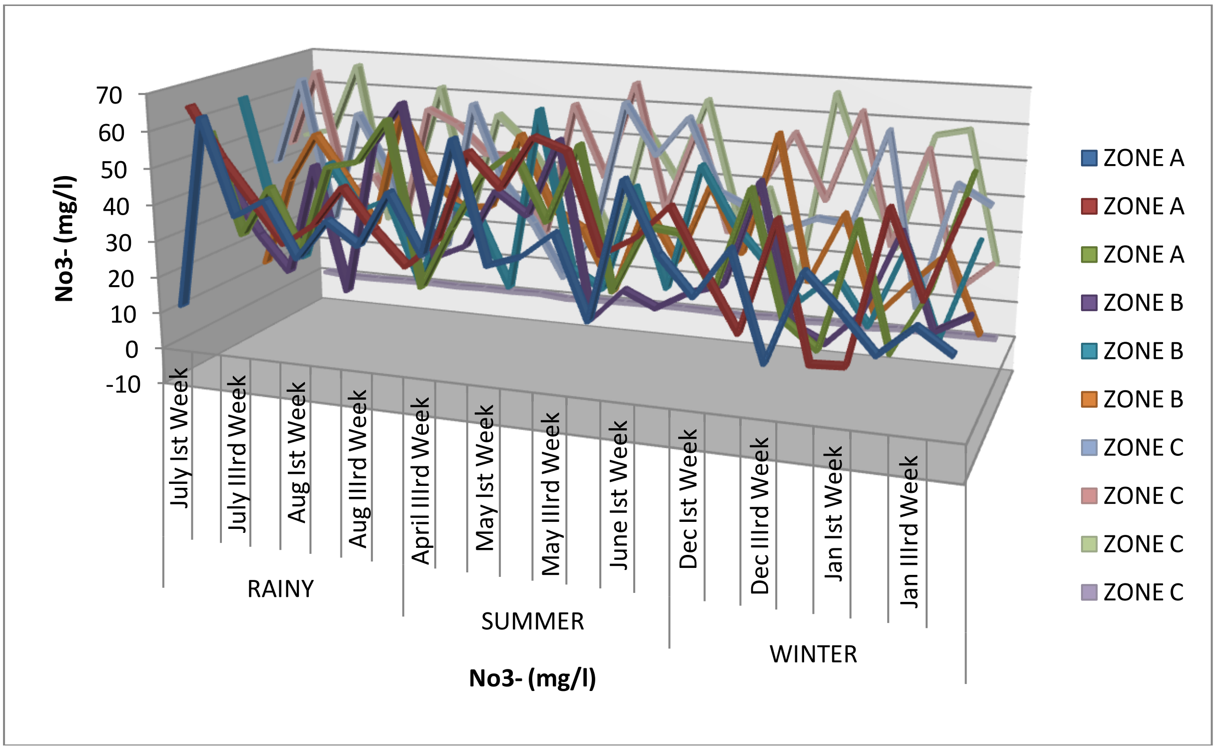

Figure 7.D.1.

Figure 7. D.1Shows the graphical representation of annually variations of No_3^- concentration for Zone A, Zone B & Zone C of three types of samples including seasonal changes.

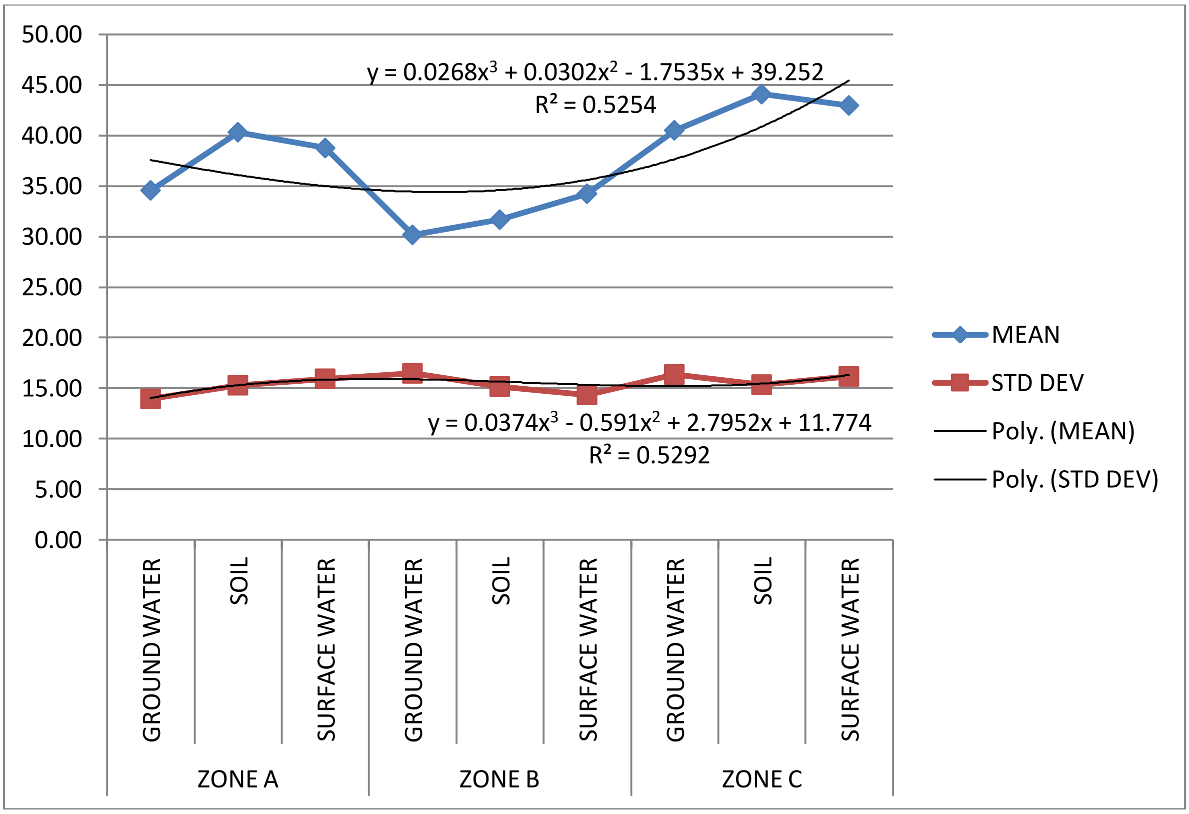

Figure 7.D.1.1.

Figure 7.D.1.1.Shows the graphical representation of mutually correlation of all the statistical parameters &NO_3^- concentration.

7.E. For Na^+ concentration

Statistical analysis of Na^+ concentration in Zone A, Zone B &Zone C in the reference of three types of samples including seasonal changes: -

Table 7.E.1.

		ZONE A			ZONE B			ZONE C			
		GROUND WATER	SOIL	SURFACE WATER	GROUND WATER	SOIL	SURFACE WATER	GROUND WATER	SOIL	SURFACE WATER	CORREL
RAINY	July Ist Week	214	206	131	122	148	149	141	172	177	0.00
	July IInd Week	139	152	149	201	119	153	98	224	135	-0.19
	July IIIrd Week	128	96	43	73	226	207	66	135	197	-0.25
	July IVth Week	88	116	197	129	71	118	115	187	145	-0.40
	Aug Ist Week	50	169	107	175	194	182	216	214	119	-0.24
	Aug IInd Week	44	218	172	43	177	175	153	118	186	-0.42
	Aug IIIrd Week	202	190	224	171	101	117	182	209	217	-0.21
	Aug IVth Week	170	85	170	69	153	89	168	129	210	-0.02
SUMMER	April IIIrd Week	112	138	141	110	133	138	121	154	155	-0.65
	April IVth Week	192	171	207	128	214	172	194	132	191	0.31
	May Ist Week	69	80	202	74	33	146	128	159	182	-0.58
	May IInd Week	29	106	142	20	52	92	91	220	161	-0.59
	May IIIrd Week	202	195	89	67	174	61	34	93	108	0.41
	May IVth Week	121	144	73	198	211	173	149	176	115	0.08
	June Ist Week	157	188	70	154	92	95	50	215	202	-0.43
	June IInd Week	23	187	186	147	140	204	208	87	127	-0.29
WINTER	Dec Ist Week	108	129	130	98	112	116	112	142	172	-0.74
	Dec IInd Week	168	161	232	71	179	146	189	183	151	0.24
	Dec IIIrd Week	26	43	106	55	193	23	72	41	102	0.19
	Dec IVth Week	45	134	138	22	158	78	118	107	161	-0.29
	Jan Ist Week	192	194	175	101	67	139	141	177	180	-0.27
	Jan IInd Week	71	63	152	140	46	200	33	100	113	-0.36
	Jan IIIrd Week	128	97	82	174	29	116	154	154	75	-0.06
	Jan IVth Week	145	215	27	126	115	86	84	214	208	-0.45
	MEAN	117.63	144.88	139.38	111.17	130.71	132.29	125.71	155.92	157.88	
	STD DEV	62.16	50.43	56.16	53.01	59.83	47.54	52.91	49.09	39.17	
	MEAN SQUARE	13835.64	20988.77	19425.39	12358.03	17084.67	17501.09	15802.59	24310.01	24924.52	
	SQUARE ROOT	10.85	12.04	11.81	10.54	11.43	11.50	11.21	12.49	12.56	
	RMS	135.90									

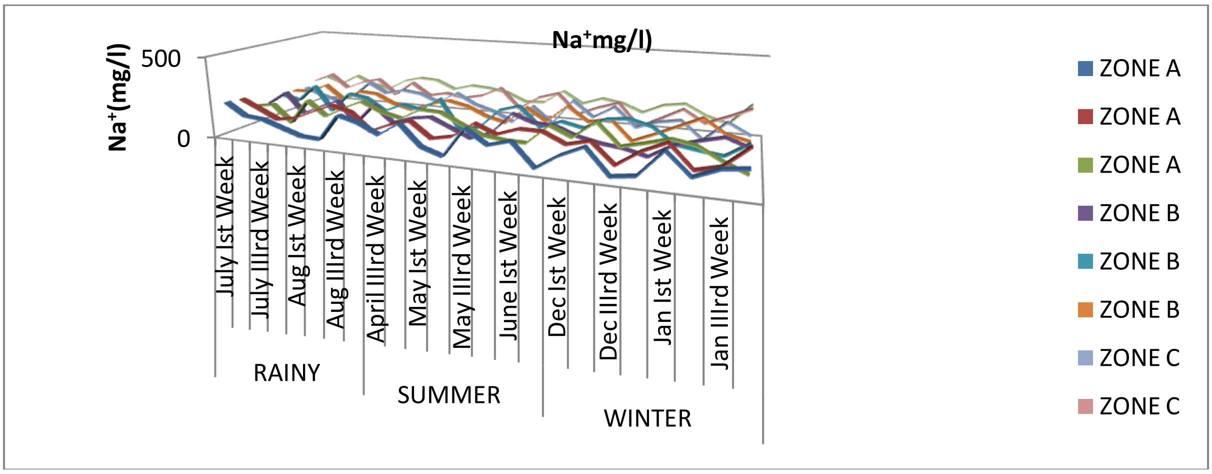

Figure 7.E.1.

Figure 7.E.1.Shows the graphical representation of annually variations of Na^+concentration for Zone A, Zone B & Zone C of three types of samples including seasonal changes.

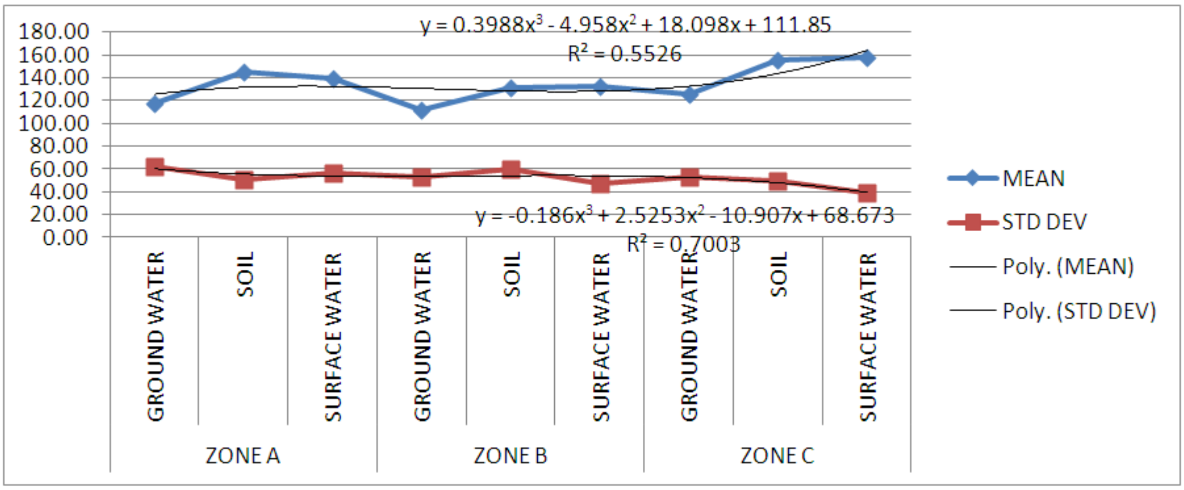

Figure7.E.1.1.

Figure7.E.1.1.Shows the graphical representation of mutually correlation of all thestatistical parameters &Na^+ concentration.

All above statistical analysis shows +ve but poor correlation & sometimes -vesignificant correlation between physiochemical parameter'sconcentration v/s various samples v/s seasonal changes for Zone A, Zone B & Zone C. As we can understand increasing concentration from Summer to rainy seasons and from Ground water to Surface water & soil samples.

While All above the statisticalfigures represent a continuous infinite parallel correlation between mean & standard deviation including some up & down.

7. Regression analysis: -

8.A.For Ca^{2+} Concentration: -

Collected calcium data with various sample such as Ground Water, Soil & Surface Water including seasonal changes in Zone A, Zone B & Zone C were analyzed by multiple

Linear regression using the excel software programme.

Ca^{2+} in ground water was considered as dependent variables & soil, surface water as independent variables for Zone A , Zone B & Zone C.

The regression equations for Ca^{2+} are represented as:

ZONE	SEASONS	REGRESSION EQUATION	R SQUARE
ZONE A	RAINY	PREDICTED GW = 164.7869907 + (-0.50853831)*SOIL + 0.15140278*SW	0.318942155
	SUMMER	PREDICTED GW = 193.2869979 + (-0.39747847)*SOIL + 0.023761361*SW	0.461892018
	WINTER	PREDICTED GW = 108.0732038 + (-0.10557117)*SOIL + 0.167806974*SW	0.133998271
ZONE B	RAINY	PREDICTED GW = 226.6661732 + (-0.23039796)*SOIL + (-0.55634955)*SW	0.379096108
	SUMMER	PREDICTED GW = -4.89475343 + 0.76556462*SOIL + 0.21777504*SW	0.692169797
	WINTER	PREDICTED GW = 205.9470079 + (-0.29585453)*SOIL + (-0.4132135)*SW	0.222769039
ZONE C	RAINY	PREDICTED GW = 77.09658134 + 0.831604798*SOIL + (-0.50599525)*SW	0.567407642
	SUMMER	PREDICTED GW = 141.2086389 + 0.270854925*SOIL + (-0.45673393)*SW	0.272295802
	WINTER	PREDICTED GW = 116.3040904 + 0.373305966*SOIL + (-0.49431913)*SW	0.556517057

Table 8.A.1.

GW- GROUND WATER, SW – SURFACE WATER

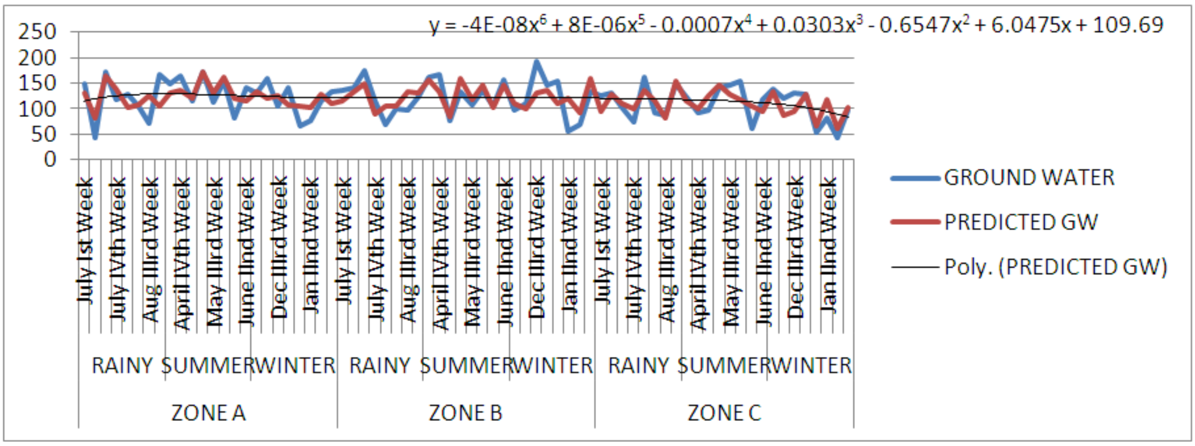

FIGURE 8.A.1

Regression equations are used to calculate predicted value. Predicted values of each observation were calculated &given in the figure 8.A.1.

A graph between measured concentration of calcium& create predicted Ca^{2+} annually shows the good correlation coefficients which reflects the effectiveness of these regression equations.

8.B.For Cl^-Concentration: -

Collected chloride data with various sample such as Ground Water, Soil & Surface Water including seasonal changes in Zone A, Zone B & Zone C were analyzed by multipleLinear regression using the excel software programmer.

Cl^- in ground water was considered as dependent variables & soil, surface water as independent variables for Zone A, Zone B & Zone C.

The regression equations for **Cl^-** are represented as: -

Table 8.B.1. Regression analysis of Cl^- ion in zone wise

TABLE NO	ZONE	SEASONS	REGRESSION EQUATION	R SQUARE
8.B.1.	ZONE A	RAINY	PREDICTED GW = 392.6054116 + (-0.457995073)*SOIL + (-0.007968281)*SW	0.365863561
		SUMMER	PREDICTED GW = -49.90961755 + 0.18647549*SOIL + 0.989825589*SW	0.795229998
		WINTER	PREDICTED GW = 310.7160617 + (-0.549976581)*SOIL (-0.157266057)*SW	0.621947011
	ZONE B	RAINY	PREDICTED GW = 67.0571638 + 0.10948637*SOIL + 0.602854366*SW	0.515401395
		SUMMER	PREDICTED GW = 308.9943492 + 0.012450512*SOIL (- 0.424160164)*SW	0.162882866
		WINTER	PREDICTED GW = 324.7684184 + (-0.590956963)*SOIL + (-	0.840221129

			0.233951538)*SW	
	ZONE C	RAINY	PREDICTED GW = 168.9040298 + 0.140041165*SOIL + 0.189878559*SW	0.090179311
		SUMMER	PREDICTED GW = 206.0206994 + 0.618210527*SOIL + (-0.581460071)*SW	0.420644351
		WINTER	PREDICTED GW = 114.9818143 (- 0.038823042)*SOIL + 0.310461973*SW	0.116632891

GW- Ground Water, SW- Surface Water

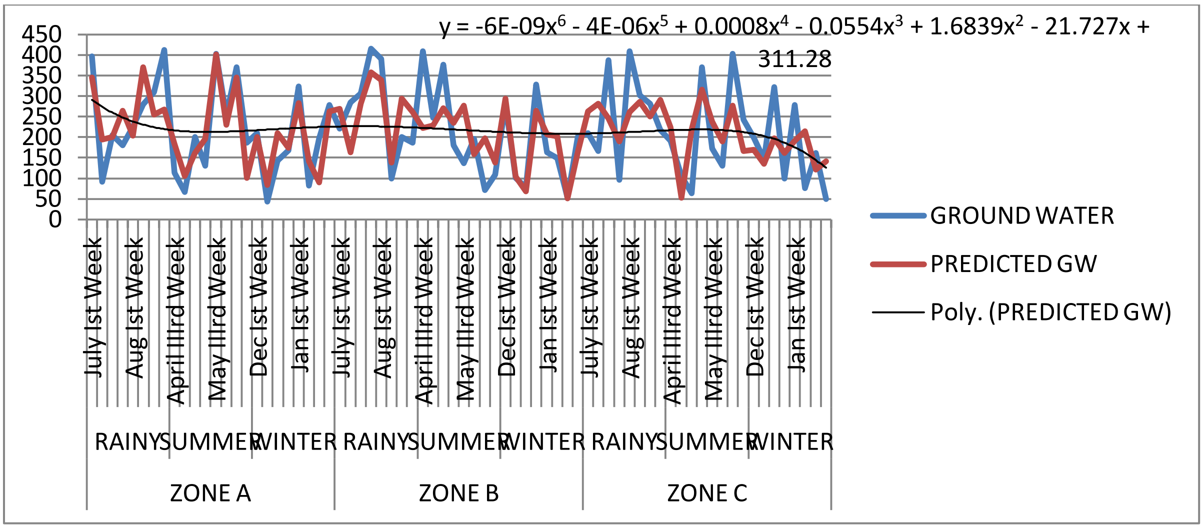

Figure 8.B.1.

Regression equations are used to calculate predicted value. Predicted values of each observation were calculated & given in the figure 8.B.1.
A graph between measured concentration of calcium &create predicted **Cl^-** annually shows the good correlation coefficients which reflects the effectiveness of these regression equations.

8.C.For Mg^{2+} Concentration: -
Collected magnesium data with various sample such
as Ground Water, Soil & Surface Water including seasonal changes in Zone A, Zone B & Zone C were analyzed by multipleLinear regression using the excel

software programmer.
Mg^{2+} in ground water was considered as dependent variables & soil, surface water as independent variables for Zone A , Zone B & Zone C.
The regression equations for **Mg^{2+}** are represented as

Table 8.C.1.

TABLE NO	ZONE	SEASONS	REGRESSION EQUATION	R SQUARE
8.C.1.	ZONE A	RAINY	PREDICTED GW = 44.11560458 + (-0.534126821)*SOIL + 0.730326981*SW	0.930035627
		SUMMER	PREDICTED GW = 40.44516005 + 0.011800126*SOIL + 0.294299268*SW	0.087395805
		WINTER	PREDICTED GW = 62.93138221 + 0.059682072*SOIL + (-0.180796197)*SW	0.040697545
	ZONE B	RAINY	PREDICTED GW = 33.0311526 + 0.507910598*SOIL + (-0.09925572)*SW	0.10821556
		SUMMER	PREDICTED GW = 96.36740769 + (-0.033881265)*SOIL + (-0.424541413)*SW	0.157247896
		WINTER	PREDICTED GW = -67.96269595 + 1.082159723*SOIL + 0.694542018*SW	0.4177387
	ZONE C	RAINY	PREDICTED GW = -3.088122656 + 0.781274234*SOIL + 0.218276843*SW	0.228115917
		SUMMER	PREDICTED GW = 92.99990816 + (- 0.718772106)*SOIL + 0.150397125*SW	0.341105781

		WINTER	PREDICTED GW = 88.19431114 + 0.379051823*SOIL + (-0.884813866)*SW	0.395719543

GW- Ground Water, SW- Surface Water

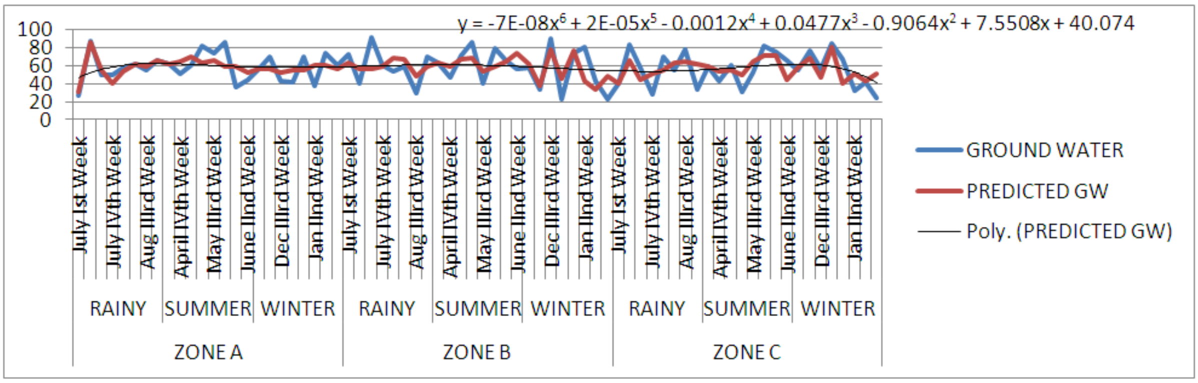

Figure 8.C.1.

Regression equations are used to calculate predicted value. Predicted values of each observation were calculated & given in the figure 8.C.1.

A graph between measured concentration of Magnesium& create predicted **Mg^{2+}** annually shows the good correlation coefficients which reflects the effectiveness of these regression equations.

8.D.For NO_3^- Concentration: -

Collected nitrate data with various sample such as Ground Water, Soil & Surface Water including seasonal changes in Zone A, Zone B & Zone C were analyzed by multiple

Linear regression using the excel software programmer.

No_3^- in ground water was considered as dependent variables & soil, surface water as independent variables for Zone A , Zone B & Zone C

The regression equations for **NO_3^-** are represented as: -

Table 8.D.1.

TABLE NO	ZONE	SEASONS	REGRESSION EQUATION	R SQUARE
8.D.1.	ZONE A	RAINY	PREDICTED GW = 67.2264924 + (-0.067519585)*SOIL + (-0.638166269)*SW	0.502407148
		SUMMER	PREDICTED GW = 14.81423253 + 0.139967739*SOIL + 0.414030878*SW	0.199049072
		WINTER	PREDICTED GW = 37.55033768 + (-0.437408919)*SOIL + 0.086985515*SW	0.730702502
	ZONE B	RAINY	PREDICTED GW = 3.107581268 + 0.333705466*SOIL + 0.546764783*SW	0.110648456
		SUMMER	PREDICTED GW = 14.5359836 + (-0.157488811)*SOIL + 0.581464765*SW	0.200168078
		WINTER	PREDICTED GW = -1.529832848 + 0.516484503*SOIL + 0.447776441*SW	0.391757519
	ZONE C	RAINY	PREDICTED GW = 46.77412786 + 0.138653455*SOIL + (-0.266780952)*SW	0.057375664
		SUMMER	PREDICTED GW = 7.216269865 + (-0.238896647)*SOIL + 1.081766428*SW	0.553491397
		WINTER	PREDICTED GW = 73.83984441 + (-0.582455912)*SOIL + (-0.246043353)*SW	0.613466506

GW- Ground Water, SW- Surface Water

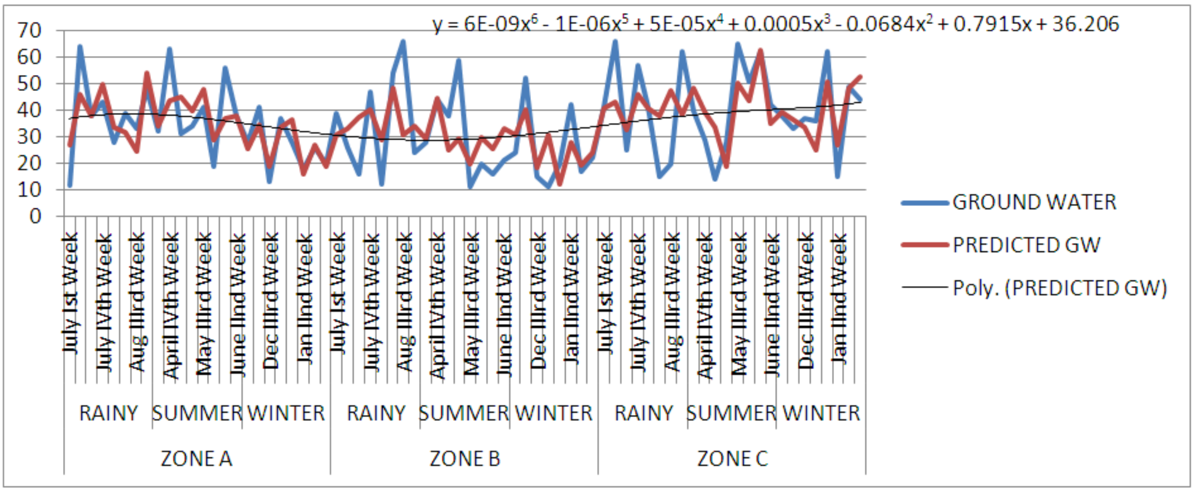

Figure 8.D.1

Regression equations are used to calculate predicted value. Predicted values of each observation were calculated & given in the figure 8.D.1.

A graph between measured concentration of Nitrate& create predicted $\mathbf{NO_3^-}$ annually shows the good correlation coefficients which reflects the effectiveness of these regression equations.

8.E.For Na^+ Concentration: -

Collected sodium data with various sample such as Ground Water, Soil & Surface Water including seasonal changes in Zone A, Zone B & Zone C were analyzed by multiple

Linear regression using the excel software programmer.

Na^+ in ground water was considered as dependent variables & soil, surface water as independent variables for Zone A , Zone B & Zone C.

The regression equations for **Na^+** are represented as: -

Table 8.E.1.

TABLE NO	ZONE	SEASONS	REGRESSION EQUATION	R SQUARE
8.E.1.	ZONE A	RAINY	PREDICTED GW = 113.7422016 + (-0.113175923)*SOIL + 0.221705888*SW	0.035495592
		SUMMER	PREDICTED GW = 32.13628066 + 0.758658642*SOIL + (-0.242620309)*SW	0.317339561
		WINTER	PREDICTED GW = -17.57053756 + 0.754727565*SOIL + 0.231925665*SW	0.644307283
	ZONE B	RAINY	PREDICTED GW = 148.592139 + (-0.938696513)*SOIL + 0.765019363*SW	0.323543765
		SUMMER	PREDICTED GW = -6.978930332 + 0.369570384*SOIL + 0.523729981*SW	0.526646611
		WINTER	PREDICTED GW = 183.0553474 + (-0.703774841)*SOIL + (-0.049521214)*SW	0.729566691
	ZONE C	RAINY	PREDICTED GW = 56.54872988 + 0.329865388*SOIL + 0.165048343*SW	0.055087953
		SUMMER	PREDICTED GW = 150.0262918 + (-0.610732504)*SOIL + 0.426796971*SW	0.172090886
		WINTER	PREDICTED GW = 79.89311412 + 0.652313522*SOIL + (-0.4005434)*SW	0.346820774

GW- Ground Water, SW- Surface Water

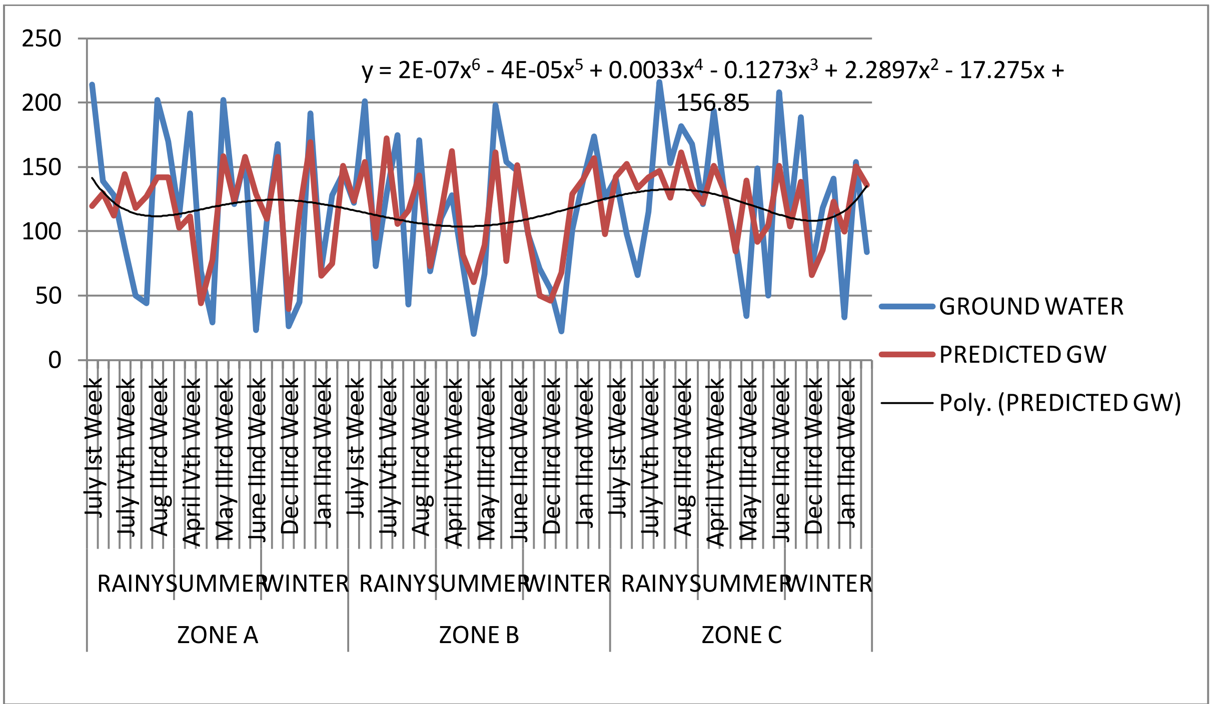

Figure 8.E.1.

Regression equations are used to calculate predicted value. Predicted values of each observation were calculated & given in the figure 8.C.1.

A graph between measured concentration of Sodium & create predicted **Na^+** annually shows the good correlation coefficients which reflects the effectiveness of these regression equations.

IV. Results & Discussions

pH: - pH values were analyzed in acceptable limits having distinct differences in different seasons like maximum in summer, minimum in rainy and maximum in surface water, soil and minimum in ground water. It ranges from 6.41 to 8.40. Rain leaches alkaline elements including Ca^{+2}, Mg^{2+} & K^+ from the soil into run off water leaving acidic elements like hydrogen, aluminum & manganese to replace the bases.

DO:-Healthywatershouldgenerallyhavedissolvedoxygenconcentrationabove6.1 to 8.4 mg/l. We found it more in surface water comparatively ground water. Dissolved oxygen was ranged from 6.1 mg/l to 8.4 mg/l all over. Which was maximum in rainyseasons.

Rising temperature causes low solubility of oxygen (Bala Krishna et al 2017, P Sharma et al 2014, S Valarmathi et al 2002, KS Rawat et al 2018, Sudarshan et al 2019, M. Thambi et al 2015).

It is found distinct increases in dissolved oxygen during rainy season (Mahamaya et al; 1996, Bindu & Ramanujan 1996, Koshy & Nayyar,1999, Gautham et al 2000, IndraBai& Geaorge,2002, Valarmathi et al 2002).

EC:-Fresh water streams range between ideally should have conductivitybetween 150 µs/cm to 500 µs/cm to support diverse aquatic life. EC is an excellent indicator of TDS & measure of salinity and (WHO,1994). It varies with sedimentary structure & composition of rock(Murlidhar&Raju,1991&(Gyananathetal;2000).Whichisbecauseofmaximumionsin conductivityfoundmaximuminrainy&minimuminwinter(PrasannaKumarietal;2003)Itrangesfrom800µs/cmto1222µs/cm.Asall27sampleswere detectedwefounditmaximum in surface water comparatively groundwater, (Bala Krishna et al 2017, P Sharma et al 2014, S Valarmathi et al 2002, KS Rawat et al 2018, Sudarshan et al 2019, M. Thambi et al 2015).

TH:-The hardness of water is a measure of the amount of lime dissolved in the water.Waterwithacalciumhardnessoflessthan100tpmisadescribedassoftwater(WHO, 1994). Total hardness was ranged from 220mg/l to 490 mg/l within permissiblelimit.

TH is found maximum in summer (P Sharma et al,2014).

TH is found maximum in surface water comparatively ground water (Patralekha et al 2006).

TDS:-AlthoughTDSlevelbetween300mg/lto-600mg/lisgoodwhyisunacceptable greater that 1200mg/l. It increases with salinity. The study area is affected by salinity, so it ranges from 442 mg/l to 1494mg/l.

Turbidity: - Acceptable limit of turbidity is 1mg/l (BIS,2012). The high values of turbidity were found due to flood & seepage (Hussain et al, 2018).
Turbidity is due to soli waste disposal & suspended matter such as clay. As we founditsdistinctincreaseduringrainyseasonsandmaximumvaluesinsurface water & soil comparatively groundwater.

Ca^{+2} & Mg^{2+}:Bot Ca^{+2} & Mg^{2+} in their compound form were detected maximum in summer & minimum in winter within permissible limit.(VC Shrivastav and KK Garg, 2014)

We found Ca^{+2} range from 42 mg/l to 197 mg/l, while Mg^{2+} 22.16 mg/l to 92.24 mg/l.

Fe^{2+}:-Fe^{2+} deficiency can be developed if the soil is too much water logged or has been over fertilized its deficiency causes chlorosis. Fe^{2+} was analyzed maximum in rainy seasonthennon-rainyseasons.Itdoesn't varytoomuch.Itsacceptablelimitis0.3mg/l(BIS,2012). It ranges from 0.06 mg/l to 0.22mg/l.

Na^{+}:-Sodiumhaving5to10ppmdesired rangewhenlinkedtoCl^{-}isoftenassociated with salinityproblems.High concentration in the soil can adversely affect turf grasses.

Poor soil physical properties for plant growth will result is consequences of continued use of water, high **Na^{+}** levels. **Na^{+}** contains more than 50mg/l max the water unsuitable for drinking purpose (Mahesha and Raju,2012).We found **Na^{+}** range from 20 mg/l to 224 mg/l.

K^{+}:-Potassiumlevelincreasesduringrainyseasonduetoleaching(CK Jain et al,2010). It is found maximum in surface water. It ranges from 1.6 mg/l to 3.6mg/l.Its permissible limit in water is 12 mg/l (BIS ,2012).We found its more amount in surface water & soil comparatively ground water.

Cl^{-}:-Chloride was estimated higher concentration because of leaching from agricultural lands. Bhanja& Patra,2000 reported that Cl^{-} contain in surface water might be due to leaching from rock sevage contamination. We found raised values in rainy seasonsofchloride(K Jain.2004, Sanap et al 2016)Andmaximumvalueinsurfacewateraboveacceptable limit.

F^{-}:-Concentration above 1.5 mg/l of Fluoride cause dental and skeleton fluorosis (Kalpana and Elango, 2013 and K Brindha, 2014).It ranges from 0.3mg/l to 1.8mg/l.

$SO4^{2-}$:-Sulphateisrelativelycommoninwater.Ithasnomajorimpactonthesoilother than contributing to the total soil content. It ranges from 102 mg/l to 258 mg/l. We found it moreduringrainyseasons.Surfacewater&soilcontainsmoreamountofSulphatethenground water. Although it is always within limits in all the studyreasons (N. Gupta et al, 2017).

$PO4^{3-}$: -Shanthi et al 2000, Pandey et al 2000 reported declined in phosphate concentrationduetoutilizationduringsummerwhilehigherconcentrationinrainyorweight season(M.Bora, DC Goswami, 2017 and P Sarah et al,2011). Some times phosphate is undetectable around Kotacity.

NO_3^{-}:-Nitrate is detected in measurable amount where drainage system is not properly. Although it may increase due to cattle's& urban wastages which leads to high load of organicwaste. It ranges from 11 mg/l to 67 mg/l. Its acceptable limit is 45mg/l (BIS 2012).

REFRENCES

[1]. Versa, G. Sudesh and Singh, S. (2013)Physico-chemical analysis of textile effluents ofDye and Printing clusters of Bagru region, Jaipur India. Journal ofEnvironmental Research and Development.

[2]. V. Kumar, Jahangeer, Mishra S,(2017) "Comparative studies of soil physicalcharacteristics of Jaipur district, Rajasthan" – African Journal ofEnvironmental Science & Technology 11 (1): 45-55.

[3]. Dev, S. Mahendra, (2012) "Small Farmers in India, Challenges and Opportunities".Indira Gandhi Institute of Development Research, Mumbai, June.

[4]. Ku Smita Tale, Dr Sangita Ingole, (2015). A Review on Role of physio-ChemicalProperties in Soil Quality, Chem Sci Rev Lett.4(13): 57 – 66.

[5]. Chourasia AK, Wani SP, Raghvendra S. (2013).Multiple impact of integratedwatershed management in low rainfall semi-arid region: a case study fromEastern Rajasthan, India. Journal of Water Resource and Protection, 5(1):27.36.

[6]. Solanki HA, Chavda NH (2012).Physio-Chemical Analysis with Reference toSeasonal Changes in Soils of Victoria Park Reserve Forest, Bhavnagar(Gujarat), Life Sciences Leaflets. 8:62-68.

[7]. Adugna A, Abegaz A(2015). Effects of Soil depth on the dynamics of SelectedSoil Properties among the highland's resources of Northeast Wolega, Ethopia:are these signs of degradation? Solid Earth Discuss.

[8]. Hossain MA, Sujaul IM, Nasly MA,(2013). Water quality index: an indicator of surfacewater pollution in eastern part of peninsular Malaysia. Research Journal ofRecent Sciences. 2(10): 10 – 17.

[9]. Kumar LD, Sateesh K. Saxena PR, Satyanarayan E, Edukonda A,(2015). Assessment ofground water quality and its suitability for drinking and irrigation purposesin Maheshwaram Area, Ranga Reddy District, Telangana State. India Journalof Environment Research and Development 9(3):523 – 529.

[10]. Sharda AK, Sharma MP,(2013). Water quality assessment of Swam River in HimachalPradesh, India. International journal of environmental sciences; 4(3).
[11]. Bhattacharya, B.N. Gosh, P.K. Mishra, B. Mandal, (2015) "Soil Degradation in India:Challenges and Potential Solutions" – Sustainable 7(4) 3528 – 3570.
[12]. Ratanlal (2016), "Soil Health" – Food and Energy Security volume 5, Issue – 4.
[13]. J.J. Cancela, T.S. Cuesta, Neira, Pereira,(2006) "Modelling for improved irrigationwaster management in a temperate region for northern Spain" – Biosystem Engineering 94(1), 151 – 163.
[14]. B.D.Strahm and Harrison,(2018). "Control on the scrption, description andmeneralisation of low molecule weight organic acids in variable charge soils"– Soil science society of America Journal 72(6), 2018.
[15]. Peverille et al, (1999). "Soil analysis: an enterpreta□on manual" – CSIROPublishing 1999.
[16]. S.Firdaus, S. Begam, A. Yasmein, (2016). "Assessment of soil quality parameters usingmultivariate analysis in the Rawal Lake watershed" – Environmental Monitoring and assessment 188(9), 533.
[17]. PS Minhas, RK Yadav, (2015). "Long Term Effect of waste water irrigation and nutrientrates II. Nutrient Balance, Nitrate Leaching and Soil properties underperiurban cropping systems" – Agricultural water management 156, 110 -117.
[18]. 18)Singh, Raghuvanshi, (2016). "Assessment of water quality in river Gomati atJaunpur (UP), India" – Annals of Plants Science 5(3).
[19]. Lipika, Dipti, Isheta, (2017). "Development of water quality index and heavy metalaccumulation of Macro Algae of Mahanadi river, Cuttack (Odisha)" – Journalof Chemical, Bio & Physical Sciences, 7(73): 651 – 658.
[20]. O.S. Afolyan, FO Ogundele, Ayo Omotayo,(2012). "Comparative Analysis of the effectof closed and operational landfills on ground water quality in Solous, LagosNigeria" – Journal of Applied Technology in Environmental Sanitation – 2 (1).
[21]. Bala Krishna, G Chelldurai, J Mahanraj, J Poongode, (2017). "Seasonalvariation inPhysicochemical characterization of tuticorin, coastal water Southeast Coastof India applied water science – 7(4), 1881 – 1886.
[22]. 22)Sharma P,Meher PK,Kumar A.,Gautam Y.P, (2014) "Changes in water quality indexof Ganga river at different locations in Allahabad" – Sustainability of waterquality and Ecology 3, 67-76.
[23]. 23) S Valarmathi, J Azariah, C Govendasamy,(2002). "Seasonal variation ofPhysiochemical parameters in estuarine & Coastal water samples of MadrasCoast, Bay of Bengal, India" – Pollution Research 21 (2), 177-185.
[24]. KS Rawat, SK Singh, SK Gautam (2018). "Assessment of Ground water quality forirrigation use:" A Peninsular case study - Applied Water Science 8, 233
[25]. Sudarshan, P. Mahesh, M.K. Ramchandra, T.U. (2019). "Assessment of seasonalvariation in water quality and water quality index (WQI) Herbal LakeBanglore, India" Environmental and Ecology 31(1B): 309 – 317.
[26]. M. Thambi, Tom Cherian, Anju Jose, Suniana, (2015). "Physiochemical characteristicsof ground water samples from different areas of Thrissur district Kerala State,India" – International Journal of Environmental 4(2).
[27]. WHO 1994 Guidelines for drinking water quality, 2 nd edition.
[28]. Patralekha et al (2006) "Maldives strugglers to reinstate Tsunami hit watersupplier (U-367)".
[29]. BIS 2012 (IS 10500:2012) Indian Standard Drinking Water Specification.
[30]. K. Hussain, Y A Maruthi, N L Das, KP Rawat, KSS Sharma ,(2018). "Irradiation ofwater with electron beam is a key to sustainable smart/green cities:" a review– Applied Water Science 8(1), 6.
[31]. VC Shrivastav and KK Garg, (2014). "Comparative study of Industrial andLaboratories prepared waste water with electro – coagulation processseparation and purification technology 128, 80 – 88".
[32]. Mahesha and Raju, (2012). "Assessment of Water Quality Index of river Godavari atRajohmundry" – Universal Journal of Environmental Research andTechnology, V-2, Issue – 3: 161 – 167.
[33]. CK Jain, Bandhopdhyay, A Bhadra,(2010) "Assessment of ground water quality fordrinking purpose, District NaintalUttarakhand, India" – EnvironmentMonitoring and assessment 166 (1 - 4), 663-676.
[34]. C & K Jain, (2004). "Metal Fractionation study on bed sediments of river Yamuna,India" – Water Research 58(3), 569 – 578.
[35]. Sanap et al:(2016). "Assessment of Ganga river Ecosystem at Haridwar, Uttarakhand, India" – Applied Water Science 6, 107 – 113.
[36]. Kalpana and Elango, (2013). "Assessment of ground water quality for drinking andirrigation perposes in Pambar river, Sub Basin, Tamil Nadu IJEP 33(11): 1 – 8.
[37]. K Brindha and L.E.lango, (2014). "Soil and Ground water quality with reference tonitrate in a semiarid agriculture region:" Arabian Journal of Geo Sciences 7,4683 – 4695.
[38]. N. Gupta, P. Pandey, J. Hussain, (2017). "Effect of Physiochemical and biologicalparameters on the quality of river water of Narmada, M.P., India" – WaterScience 31 (1), 11-23.
[39]. M.Bora, DC Goswami, (2017). "Water Quality assessment in terms of water qualityindex: case study of the Kolong river, Assam, India", Applied Water Science,7(6), 3125 – 3135.
[40]. Stave, ED ungar, H.Lavae, P Sarah,(2011)."Soil aggregate fraction 1-5 mm anindicator for soil quality in rangelands" – Journal of Arid environment 75(11),1050 – 1055.

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