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PHYSICO-CHEMICAL ASSESSMENT OF RIVER CHENAB, JAMMU AND KASHMIR

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ABSTRACT

The present study assesses some physico-chemical parameters of the mighty river Chenab which is a major river of India. It originates in the upper Himalayas in the Lahaul and Spiti district of Himachal Pradesh, India, and flows through the Jammu region of Jammu and Kashmir into the plains of Pakistan. The present study revealed that the range of some physico-chemical parameters were 3-36.5^{0}C (air temperature), 1-20 ^{0}C (water temperature), 3- 152cms (transparency), 7.3-8.8 (pH), 4.4-14.8 mg/cl (DO), 1- 6 mg/lt (free carbon dioxide),1-6 mg/lt (carbonates), 24-169 mg/lt (bicarbonates) and 21-169 mg/lt (Chlorides), 3.8-36.09mg/lt (calcium) and 2.6-16.03 mg/lt (magnesium). The physico-chemical characteristics of river Chenab at different stations indicate that the river doesn't exhibit any deteriorating (nutrient pollution) trend as yet.

KEYWORDS: Chenab, Physico-chemical, Nutrient pollution.

INTRODUCTION

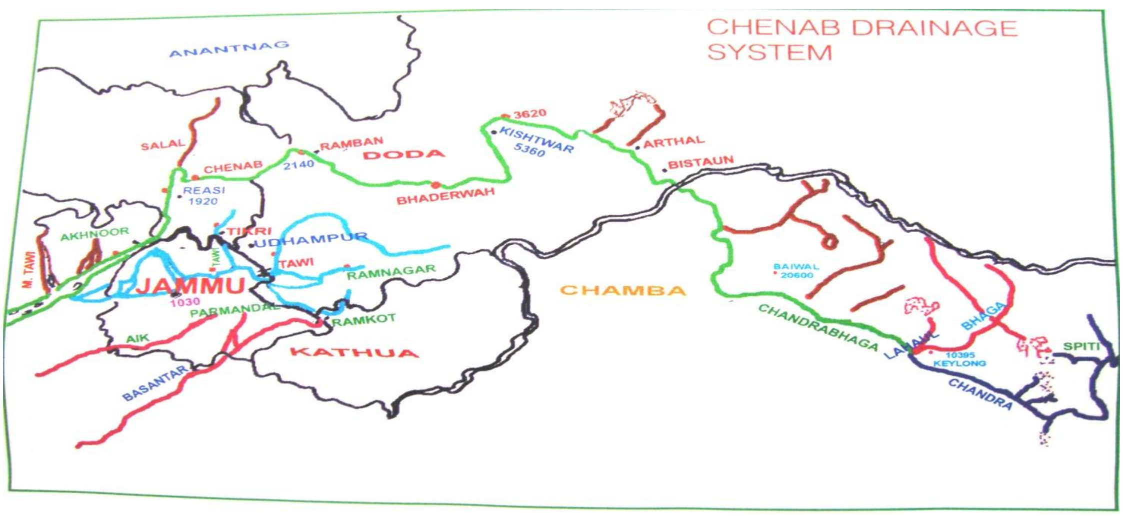
Rivers form the basis of human civilization. From a hydrological perspective, rivers play a central role in the global cycling of water between sea, air and land. Along with underground aquifers, they gather precipitation and carry it as runoff to the sea, which then cycles moisture back to the land via the atmosphere. This cycle constantly renews the finite supply of water on the continents thus sustains life on land. From a human standpoint, rivers are principal sources of water for drinking, cooking and bathing for growing crops where rainfall is not sufficient, for generating electric power and for manufacturing all manner of material items **(Postel and Richter, 2003).[1]**

Over the last hundred years and sometimes even more, water chemistry has gradually changed in rivers with major human activities and water uses. These impacts are dependent on the nature and relative importance of these activities and they affect differently the various chemical indicators **Meybeck (2002)**.[2] It is pertinent therefore, that the physico chemical properties of water be carried out so that the optimum levels are known so that its portability can be assessed for both human as well as flora and fauna inhabiting it.

METHODOLOGY

STUDY AREA

The river was horizontally divided into zones and a study station for each zone was established. The division of river into study zones was made on the basis of variations in bottom structure or close to confluence of a stream / nallah with the main river. Apart from studies on the main river, some study stations were carved along major tributaries, that influence the river ecology through influx of abiotic and biotic materials, which they produce or import from the catchment areas. The river along its length was divided into 12 study stations namely Bhandarkot, Thatri, Pul-Doda, Ramban, Reasi and Akhnoor, Neota, Pouni, Anji, Jhajjer Kotli, Katal Batal and Jammu Tawi so that a comprehensive picture about the river ecosystem could be brought forth. Six study stations on different streams that enter river Chenab at different locations along its course was raised namely Neota, Pouni, Anji, Jhajjar Kotli, River Tawi (Katal Batal and Jammu City).



WEATHER

Altitudinal and floral variations in the Jammu province of Jammu and Kashmir state, subject it to spatially variant climates. Depending upon the prevailing weather conditions, the area can be said to experience three sharp seasons with in a year viz.,

1. Summer (late April to late June) in which weather remains bright sunny and temperature varies from 25 ^{o}C to 37 ^{o}C.
2. Rainy season (late June to mid September) when weather remains cloudy and area experiences monsoon rains.
3. Winter (late November to late February) when temperature remains within -3 ^{o}C to 20 ^{o}C and other weather conditions like snowing and fog etc. vary considerably, depending on the altitude.

During rainy season, the weather remains cloudy, with intermittent and heavy rains that may impede the rate of photosynthesis by terrestrial as well as aquatic autotrophs. In the river under study, the phenomenon of photosynthesis is further influenced by the turbidity (influx of inorganic and organic matter) caused through the influx of rain water from catchment areas. Winters, however, are bright sunny except for small western disturbances which result in moderate to heavy snowfall in middle and upper Himalayas. The low temperature coupled with little influx of rain water, results in acquisition of pristine clear status of river during winters. The sandy, shingle / rocky bed of river with exceptionally low currents prove this to be a good period for autochthonous production of organic matter through photosynthesis.

Physico-chemical Parameters

Temperature

Air and water temperature were recorded by using a mercury bulb thermometer. Air temperature was recorded by keeping the thermometer in shade. Water temperature was recorded by placing the bulb of the thermometer four to five inches below the surface of the water for about 2 minutes at each station.

Transparency

Water transparency was measured with the help of Secchi disc (painted black and white) having a diameter 20 cms by using the following formula.

T = $\frac{X + Y}{2}$ **(A.P.H.A., 1985)**

T = Transparency in cms

X = Depth at which disc becomes invisible

Y = Depth at which the disc reappears while pulling the rope.

pH

pH of the water was determined by using a portable pH meter (Hanna, model).

DO

Dissolved Oxygen of the water was determined by Sodium azide modification of Winkler's method **(A.P.H.A., 1985).**

Free Carbon Dioxide

FCO_2 was estimated by titrimetric method recommended by **A.P.H.A. (1985).**

Carbonates and Bicarbonates

Carbonates and bicarbonates were estimated as per **Indian Standard Method (1973) and A.P.H.A. (1985).**

Chloride

Argentometeric method using potassium chromate as indicator was adopted for the estimation of chloride **(A.P.H.A, 1985).**

Calcium and Magnesium

The estimation of Ca^{++} and Mg^{++} was done by the method suggested by **I.S.I (1973) and (A.P.H.A.1985).**

RESULTS AND DISCUSSION

Atmospheric temperature

The atmospheric temperature varied considerably both spatially as well as temporally. The range of variations recorded reveal that the minima of temperature varied between 3^{o}C (Station Bhandarkot) to 36.5 ^{o}C in May (2000) along the river course presently investigated.

TABLE 1: Showing the range of air temperature at different stations of river Chenab.

S. No.	Station	RANGE	
		2000-2001 (^{o}C)	2001-2002 (^{o}C)
1.	Bhandarkot	3 - 30	4 - 23.5
2.	Thatri	10 - 30	4 - 23.5
3.	Pul-Doda	7 - 34	8 – 29
4.	Ramban	12 - 32	9 - 30.5

5.	Reasi	16.5 - 32.5	16 – 34
6.	Akhnoor	18 - 36.5	14 – 35

Thus, it is apparent that the river runs through distinct thermal sections which may inturn cast their influence on the water temperature thereby influencing the overall productivity of this riverine system.

WATER TEMPERATURE

Perusal of Table 2 further reveals that

i. annual thermal changes recur in almost identical ranges at each of the study stations.

ii. the river water temperature steadily increases with its journey towards the plains.

iii. range of variations as recorded here under show steady increase as the river flows from upper head zone to mid plains.

TABLE 2: Showing the range of water temperature at different stations of river Chenab.

S. No.	Station	RANGE	
		2000-2001 (^oC)	2001-2002 (^oC)
1.	Bhandarkot	1 - 13	2 – 12
2.	Thatri	4 - 15	3 – 14
3.	Pul-Doda	3 - 15	3 - 12.5
4.	Ramban	5 - 16	4.5 – 16
5.	Reasi	6.2 - 19	6 – 20
6.	Akhnoor	7 - 18.5	4 – 20

Thus on the basis of water temperature variation from 1o C to 20^{o}C in the 328 Km section, the river can be classified as cold water river. The pattern of thermal changes of river Chenab in upper and middle Himalayas are similar to the one recorded for other Himalayan rivers, Sutlej[3] **(Joshi, 1996)**, Jehlum[4] **(Nyman, 1999)** etc. which are also the tributaries of Indus drainage system.

Transparency

Variations in transparency may be owed to two primary reasons viz., autochthonous production of plankton whose swarm of populations may impede light penetration and the suspended inorganic matter which results in turbidity and checks light penetration. The later plays a major role in stalling the light penetration. Suspension in rivers as source of turbidity may be because of one or more than one of the following reasons.

I. Nature of the river basin.

II. Allochthonus supply of materials which may include.

a) Entry of materials through soil erosion.

b) Entry of materials along with drains entering the river.

c) Materials finding entry through winds.

III. Anthropogenic influences

a) Developmental works like hydroelectric project, construction of bridges, road, dams and barrages over the rivers.

b) Transportation through the rivers, particularly of timber.

c) Socio-economic activities in and around the river.

IV. Nature and type of catchment area.

V. Speed of the river water.

TABLE 3: Showing the range of Transparency at different stations of river Chenab.

S. No.	Station	RANGE	
		Ist Year (cms)	2nd Year (cms)
1.	Bhandarkot	5 - 90	7 - 129
2.	Thatri	3 - 71	5 - 115
3.	Pul-Doda	4 - 88	4 - 121
4.	Ramban	6 - 112	7 - 121
5.	Reasi	3 - 125	4 - 130
6.	Akhnoor	2 - 136	5 - 152

The increase in transparency from September onwards till April in river Chenab and also in other tributaries of Chenab water shed may be due to;

i) considerable fall in speed / velocity of water,

ii) absence of rains during the period discussed above that were responsible for importing debris and other forest litter to the river system and

iii) low temperature that leads to the settlement of most of suspended material.

pH

The water of river Chenab is alkaline, as is evident from studies carried spatially as well as temporally (Table 4). The pH values range between 7.4-8.9, being lowest in summer and monsoon months when the river was swollen with floods and highest during winter. The observed increment in pH value during winter months appears to be influenced by.

(i) low water level, better interaction between lime stone deposits and water and

(ii) growth of phytoplanktons (especially diatoms) as has earlier been suggested for many other water bodies **5,6,7 (Joshi, 1996 ; Sunder, 1996; Hassan ET AL , 1998)**. Very small range of fluctuations in pH, spatially and temporally, suggest that there occurs a very strong buffering mechanism in river Chenab.

The river from point of view of its pH range can be said productive as per the evaluation of **8Dudroff and Kautz (1950)** who maintained that pH below 4 and above 10 is hazardous to fish.

TABLE 4: Showing the range of pH at different stations of river Chenab.

S. No.	Station	RANGE	
		2000-2001	2001-2002
1.	Bhandarkot	7.6 - 8.7	7.7 - 8.8
2.	Thatri	7.4 - 8.6	7.5 - 8.7
3.	Pul-Doda	7.5 - 8.7	7.6 - 8.8
4.	Ramban	7.7 - 8.7	7.6 - 8.8
5.	Reasi	7.5 - 8.6	7.5 - 8.7
6.	Akhnoor	7.3 - 8.6	7.4 - 8.7

Dissolved Oxygen

Rivers / lotic waters usually have a higher amount of DO because of water movement / speed of water current / or turbulences and mixing of surface water that dissolves oxygen from air. The amount of DO present in H_2O in turn depends on atmospheric pressure and temperature both of which vary considerably with altitude. The DO concentration in river Chenab is comparatively higher in head waters as compared to the DO content of water in middle plains or lower zone of present study (Table 5).

Under natural conditions, the running water typically contains a relatively higher concentration of dissolved oxygen tending towards saturation. The higher values of dissolved oxygen recorded in the river Chenab during winter season (December, January, February, March) in general and more so in tributaries could be an overall cumulative effects of, (i) low temperature, (ii) an increase in transparency, (iii) low water speed and (iv) growth of plankton and other periphytonic vegetation.

The below depicted range of variations in DO at different study stations (Table 6) further reveals that DO range is slightly varied at stations Bhandarkot, Thatri, Pul-Doda Ramban, Reasi, Akhnoor besides the fact that DO is minimal at stations Reasi and Akhnoor during rainy season as compared to head waters (Bhandarkot). The fall in DO besides the natural operations at these stations may also be due to anthropogenic influences which are evidenced from the fact that these study sites are closely flanked by townships along the entire length of the river Chenab. These are thus, the sites where lot of sewage enters the river, some settles (solid) down and get decomposed, besides several kinds of religious rituals are also preformed in and around these stations along the river profile. The overall impact of these anthropogenic activities has been significantly casted upon the DO content as indicated below.

TABLE 5: Showing the range of Dissolved Oxygen (DO) at different stations of river Chenab.

S. No.	Station	RANGE	
		Ist Year (mg/l)	2nd Year (mg/l)
1.	Bhandarkot	7.6 - 12.4	6.0 - 12.8
2.	Thatri	5.6 - 11.2	6.0 - 12.4
3.	Pul-Doda	6.0 - 12.4	6.0 - 14.8
4.	Ramban	5.8 - 12.4	6.0 - 13.6
5.	Reasi	4.4 - 13.6	6.0 - 12.4
6.	Akhnoor	4.8 - 13.6	5.6 - 12.8

Free Carbon dioxide

Carbon dioxide enters into the medium from five vital sources as;

i) from atmosphere by diffusion ,

ii) through the bacterial decomposition (oxidation and fermentation),

iii) by respiration of the biota ,

iv) precipitation and agitation of rain water and

v) mud metabolism.

In river Chenab, the higher concentration of FCO_2 during summer may be attributed to the decay and decomposition of organic matter in water and soil, as also suggested by 9**Voznaya (1981)** as well as higher respiratory activities of the inhabiting population therein as indicated by 10**Jhingran (1978).** It's decreased utilization and increased accumulation in the system may be attributed to the rise in temperature during summer period, as has been already suggested by 11**Bhowmick and Singh (1985),** besides, the inflow of sewage and faecal matters and organic decomposition. It is also suggested that organic pollutants may be considered as causative agents to create the organic decomposition and thus increasing the level of FCO_2 in the water. The present results are also in line with the above finding, particularly in the stations located at lower altitudes. During rainy season, FCO_2 is quite significant at all the stations which may be due to surface run off, inflow of ground water and high water current. Further during this season the phytoplankton population is poor and thus

FCO_2 produced through the biotic respiration is not fully consumed during photosynthesis and hence its accumulation occurs in greater amount.

A perusal of table 6reveals that during winter season the free CO_2 level remains low or absent. This may be attributed to low metabolism and decomposition and its consumption by phytoplankton during photosynthesis.

Lower value of FCO_2 in the Chenab riverine system throughout the years of present investigations at various stations is in line with the finding of **12Rai and Dutta (1979)** who have also reported that FCO_2 seldom occur in river water. **13Bhattacharya and Saha (1988)** also reported that high value of FCO_2 is uncommon in running waters.

TABLE 6: Showing the range of Free Carbon dioxide (FCO_2) at different stations of river Chenab.

S. No.	Station	RANGE	
		Ist Year (mg/l)	2nd Year (mg/l)
1.	Bhandarkot	1 - 4	1 - 3
2.	Thatri	1 - 5	1 - 4
3.	Pul-Doda	1 - 4	1 - 4
4.	Ramban	1 - 4	1 - 4
5.	Reasi	1 - 5	1 - 4
6.	Akhnoor	1 - 6	1 - 5

Carbonate

In river Chenab it has been observed that carbonate ranges between 3 mg/l to 18 mg/l. Carbonate remains absent during summer and monsoon months. (Table 8) 14**Jhingran (1978)** has already indicated that at pH range 4.5 to 8.3, the carbonate value remains low and dominated the presence of free CO_2 and bicarbonates. The *op. cit* statement can also hold true for the findings conducted in river Chenab.

Summer and monsoon absence of carbonate may be attributed to the presence of FCO_2 which appears largely due to various climatic and anthropogenic influences viz,

i. process of decomposition of bottom deposits;
ii. drifting of phytoplankton and vegetation which results in an increase in FCO_2 and
iii. influx of sewage etc.

Water rich in FCO_2 is comparatively less alkaline and vice-versa. During the present investigations, higher level of carbonates in winter as compared to summer and monsoon when FCO_2 was present was also recorded. Rise in carbonate after September till March as observed is concomitant with a fall in bicarbonate owing to the consumption of FCO_2 during photosynthesis.

TABLE 7: Showing the range of Carbonate (CO_3^{2-}) at different stations of river Chenab.

S. No.	Station	RANGE	
		Ist Year (mg/l)	2^{nd} Year (mg/l)
1.	Bhandarkot	9 - 15	9 - 18
2.	Thatri	6 - 18	4.5 - 12
3.	Pul-Doda	6 - 12	3 - 12
4.	Ramban	9 - 18	6 - 15
5.	Reasi	6 - 15	6 - 15
6.	Akhnoor	6 - 15	9 - 18

Bicarbonate

Perusal of Table 8 reveals that bicarbonates were present throughout the study period at all the stations presently investigated and their concentration fluctuated from 21 mg/l - 169 mg/l.

The rise in HCO_3^- levels in river Chenab from April onwards upto September establishes a direct relationship with FCO_2 whose concentration also records periodic increase during this period. The rise in bicarbonates recorded may be attributed to the additional influx through rainfall and surface runoff. Surface run-off generally leaches the surrounding sandy rocks of their calcium carbonate which subsequently are converted into soluble bicarbonates.

Decay and decomposition of the organic matter during summer and monsoon months as chief contributory factor for enhancement of bicarbonate levels thereby releasing FCO_2^- which thus combines with the carbonates and forms the bicarbonates can also hold true for the present observations regarding carbonates increment in Chenab River.

According to **15Daborn and Clifford (1974)** bicarbonate increases in summer due to release of compounds previously locked up in frozen mud.

The findings of **16Hynes (1970)** also indicated that waters are always having appreciable levels of bicarbonate which may also be true for the presently investigated Chenab river system where higher levels of bicarbonates has been recorded during present study period. It has also been observed that bicarbonate in river Chenab has recorded its higher levels as compared to carbonate. These differentiations in distribution of bicarbonate and carbonate may be due to the fact that the most important carbonate of aquatic system i.e. $CaCo_3$ remains almost insoluble in water but it dissolves readily as bicarbonate.

TABLE 8: Showing the range of Bicarbonate (HCO_3^-) at different stations along river Chenab.

S. No.	Station	RANGE	
		Ist Year (mg/l)	2nd Year (mg/l)
1.	Bhanderkote	27 - 67	30 - 73
2.	Thatri	24 - 115	30 - 137
3.	Pul-Doda	27 - 73	27 - 103
4.	Ramban	47 - 93	30 - 169
5.	Reasi	21 - 137	30 - 165
6.	Akhnoor	48 - 167	39 - 167

Chloride

Water being a universal solvent, dissolves chloride varies readily. In aquatic systems, particularly rivers its sources are highly variable. The presence of chloride and its variability along the river course may be a consequence of dissolution of chloride salts from the ground / river bottom, the nature and quality of which changes along the river length.

Additional receipts are also made directly through rains and surface runoff from the catchment areas and other domestic sewage finding entry into the river. Use of detergents along the river banks during bathing and washing is another anthropogenic influence that releases a lot of chloride in the water.

In river Chenab, the Chloride content of water is low, both at a given time as well as during different seasons at Bhandarkot compared with other study stations i.e., Thatri, Pul-Doda, Ramban, Reasi and Akhnoor (Table 10). The differences in Chloride content between Bhandarkot and other study stations may be due to,

a) it being close to the source of origin (snow capped mountains) hence with a comparative small volume of water for percolation through soil to acquire Chlorides.
b) Inadequate receipts from allochthonus sources because of little internal production (organic) and decomposition.

In the present study, higher chloride value was recorded during summer (June) and winter (December - January). The highest concentration of Chloride (7.98 mg/l) was recorded in the month of June at 160 ^{0}C (water temperature) at station Akhnoor in the downstream area whereas lowest Chloride value (4.99 mg/l) was recorded at station Bhadarkot in the month of June at 12^{o}C (water temperature). These variations presently recorded in the longitudinal profile of river Chenab could also be linked to temperature variations, temperature linked microbial activities and low water speed during winter and related anthropogenic influences operating in and around the Chenab riverine system.

In river Chenab, minimum value of Chloride was observed in the rainy season (0.99 mg/l - 3.99 mg/l). A similar observation was made by **Shukla *et al.*, 1989** who attributed it to the dilution because of influx of rain water. The above said fall in Chloride content in river Chenab, therefore, can be due to rise in water volume through monsoon rains and a concomitant increase in water flow rate.

The fall / rise in concentration of Chloride at stations Reasi and Akhnoor during extreme summer or winter, which are not in consolation of the expected ionic exchanges, are inturn due to anthropogenic reasons and also consumptions by the plant (stretch being in plains) during photosynthesis. Similar opinions about release of Chloride from the lithic / soil sources **(Gurjer, 1975)** and anthropogenic influences **(Boralker, 1981)** have been well documented.

Placed here under is the range of variations observed in Chloride content. At none of these stations the Chloride value has exceeded 7.98 mg/l. This Chloride concentration is too small, when compared with the value of 250 mg/l as in the water to be referred as polluted. **(Tresh *et al.*, 1944; United States Public Health Services, 1962,: WHO, 1963; Choudhury *et al.*, 1979 and Saad and Samir, 1979).**

TABLE 9: Showing the range of Chloride (Cl^{-}) at different stations of river Chenab.

S. No.	Station	RANGE	
		Ist Year (mg/l)	2nd Year (mg/l)
1.	Bhanderkote	27 - 67	30 - 73
2.	Thatri	24 - 115	30 - 137
3.	Pul-Doda	27 - 73	27 - 103
4.	Ramban	47 - 93	30 - 169
5.	Reasi	21 - 137	30 - 165
6.	Akhnoor	48 - 167	39 - 167

Calcium

According to **Ohle (1934),** waters with calcium values above 25 mg/l are classified as "Calcium rich". In the present observation, river Chenab recorded Calcium between 3.208

mg/l - 34.887 mg/l slightly higher than the prescribed level. The rise in Calcium content during autumn and winter months could be attributed to its great solubility at lower temperatures, while during summer and monsoon months, the decline in the values of Calcium might be on account of its dilution as a consequences of mixing of run-off water from rain and its utilization by the phytoplankton in the river **(Swarup and Singh, 1979)** (Table 10).

Since calcium is one of the most abundant and easily measured ions. One might expect an analogy between terrestrial and aquatic ecology through the presence of aquatic Calciphobes (Calcium-hating organism) and Calciphites (Calcium-loving organisms). There is little evidence to prove that planktonic algae exhibits such traits. **Lund (1965)** suggested that calcium acts as a buffer on water pH. With a few exceptions, invertebrates with high-Calcium demands are apparently favored in high-calcium waters.

The hardness of water is caused by concentration of Calcium and Magnesium. The present observations on river Chenab reveal that the hardness was maximum during winter. **Gusain (1994)** reported that winter water remains supersaturated with carbonates due to low water temperature, thus increasing the calcium hardness.

TABLE 11: Showing the range of Calcium (Ca_2^+) at different stations of river Chenab.

S. No.	Station	RANGE	
		Ist Year (mg/l)	2nd Year (mg/l)
1.	Bhandarkot	6.015 -17.644	5.614 -19.649
2.	Thatri	5.614 -22.857	3.809 -23.258
3.	Pul-Doda	6.015 -28.07	4.411 -24.461
4.	Ramban	6.015 -29.473	5.213 -19.649
5.	Reasi	6.015 -34.877	6.015 -22.456
6.	Akhnoor	5.213 -36.09	10.025 -24.862

Magnesium

In the present observations, Magnesium recorded its higher concentrations (16.037 mg/l) during winter months (January-February) which could be attributed to low water level, whereas low concentration (2.187 mg/l) recorded in the monsoon months (July-August) may be linked with heavy rainfall **(Sutcliffe and Carrick (1973)** which ultimately causes dilution of water (Table 12).

TABLE 12: Showing the range of Magnesium (Mg_2^+) at different stations of river Chenab.

S. No.	Station	RANGE	
		Ist Year (mg/l)	2nd Year (mg/l)
1.	Bhandarkot	4.131 -8.991	3.402 -11.664
2.	Thatri	3.645 -7.776	2.308 -8.262
3.	Pul-Doda	2.673 -12.392	2.187 -10.449
4.	Ramban	3.645 -13.000	4.009 -9.477
5.	Reasi	4.374 -15.552	4.131 -13.122
6.	Akhnoor	4.131 -16.037	2.916 -13.608

CONCLUSION

The physico-chemical characteristics of river Chenab at different stations indicate that the river doesn't exhibit any deteriorating (nutrient pollution) trend as yet. However, the various anthropogenic effects like construction of bridges, barrages, Hydro electric projects, dams, raw sewage and domestic effluents find way in appreciable quantities regularly into the river and may eventually cause the change in the present tropic condition of the ecosystem making it unfit for biota especially the fish. The water characteristics at high altitudes compared to plains indicate a considerable change in the physico-chemical parameters.

The river Chenab has been observed to remain turbid during late summer and monsoon and the turbidity is due to soil-erosion, caused mostly as a result of heavy snow melting and steep gradient that results in fast water current that cut the margins and bottom by pouring in silt and organic matter flowing in from mountain forests. The added run off from catchment areas further aggravates the condition of the biota in the system. Toxic wastes, radioactive and heat contents are not the problems of the river under investigation. Domestic waste to some extent is one of the chief putrescible waste but probably it must be rapidly getting oxidised upon entering river ***(*Taylor, 1948 and Coker, 1954*)*.**

During the present studies the depletion of dissolved oxygen or enhancement of any other chemical parameter was not observed even at station Akhnoor, which is a farthest location from river origin that receives all the civic effluent upstream. Moreover, it was observed from the water quality parameters of river Chenab that these are more or less parallel to those analyzed for some trout streams of the Kashmir valley by **Kumar and Bhagat (1977) and Qadri, *et al.* (1981).** The overall picture drawn on water quality is supportive of the cold water fishes especially snow trouts (Schizothoracids), whereas trouts (Salmonids) cannot thrive in the ecosystem which require much clear and less silty water.

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