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Epilithic Periphyton and Detritus Ecology of the Spring-fed Stream Eastern Nayar in Garhwal Himalaya

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Abstract

The paper deals with the study of epilithic periphyton and detritus standing stock in the river Eastern Nayar, which forms an important part of the food for macrozoobenthos and the fish, thus contributing greatly to the productivity of the stream.

Introduction

Epilithic periphyton and detritus plays an important role in the lotic environments where the current does'nt allow plankton to stay on in a considerable quantity. The fish inhabiting these streams mostly feed on the macrozoobenthos and the phytobenthos along with the detritus. It is the riparian vegetation, which usually contributes the detritus. Eastern Nayar is the parent stream of the Nayar that originates in the Doodhatoli peak at an elevation of about 3116 masl and confluences with other stream, the Western Nayar at Nagun Kamand near Satpuli at an elevation of about 650 masl.It is rich in carni-omnivore, omnivore and detritivore fishes. The Nayar basin is one of the important drainage basin in the Ganges river system and consists of 1997 km^2 area extending from 29^0 45' to $30^0$15' latitude and $78^0$34' to $79^0$12' longitude (Survey of India toposheet No. 53 N/4, 0/1, J/12, J/16, K/13, K/14 and K/9).The authors while conducting studies on the food and feeding biology of fishes inhabiting the Nayar river observed that the epilithic periphyton and the detritus is main food of many fishes, hence it was decided to conduct some ecological studies on these two neglected aspects.

Materials and Methods

The physico-chemical parameters were analysed by the standard methods (Welch, 1948, APHA,1975). For the quantitative estimation of periphytic algal biomass, the sample was taken from a known surface area, in centimeter square from each sampling spot. After scrapping, the periphytic algal was preserved in 5% formalin solution and was brought to the laboratory for further analysis. In laboratory, the algae collected from known area (i.e. 1cm^2 or otherwise calculated accordingly) was concentrated in either 50ml or 100 ml depending upon its concentration. The counting was made in sedgwick-Rafter counting chamber. Calulation was made as follows:

$$n = (a \times 1000) \times b$$

Where n= number of units of periphyton/ cm^2, a = Average number of periphyton in 1 chamber of 1 mm^3 capacity, b= Concentration prepared in ml.

For dry biomass, another sample of periphytic algae from 1cm^2 area was collected and dried at 105^0C in oven.For Ash free dry weight biomass, the same sample was further dried at 550^0C in a muffle furnace and biomass was measured. The estimation of the standing detritus associated with one meter square substratum up to a depth of approximately 15cm. was done. In the laboratory,

detritus was oven dried to constant weight (at 70^0 C). The final values were expressed in gram Dry weight/m^2.

Results and Discussion

The seasonal values of physico-chemical parameters in the Eastern Nayar are presented in the Table1 and the data relating to epilithic periphyton and detritus is presented in the Table 2.

Water temperature and current velocity are two important physical factors that affect the entire ecology of a lotic system.River Eastern Nayar had a moderate water temperature round the year due to its spring-fed nature of origin. It was maximum 24. 07 $\pm$ 3.89^0C during the monsoon months (June-August) and was minimum 11.45 $\pm$ 2.43^0 C during winter. The velocity or water current was also not too high if we compare it with the other hillstreams like Bhagirathi, Alaknanda and the Mandakini. It was due to less gradient in the stream during its course downwards. A maximum velocity was recorded as 0.563 $\pm$ 0.194 m/sec during monsoon and the minimum was 0.33 $\pm$ 0.05 m/sec in the Winter-Autumn. Due to moderateness in these two important physical parameters, the stream becomes conducive for the growth of periphyton as well as the detritus. And because the marcozoobenthos and fish feed on them, the entire productivity of the stream is positively affected. This observation lends support to Dobriyal and Singh (1988) and Dobriyal *et al.* (2002). River Mandakini, a glacier-fed river was studied by Negi (1998) who reported that due to low water temperature and high velocity of water current the river was less productive in comparison to the spring-fed streams.

The dissolved oxygen contents were quite high in the stream due to primary productivity activities of the periphyton (Dobriyal, 2003)and clarity of water due to less anthropogenic activities. It was recorded as high as 11.35 $\pm$ 0.33 in the winters when the respiratory activity of the biota also ceases due to less bacterial activities. It was lowest 9.15 $\pm$ 0.72 in the monsoon due to influx of organic and inorganic ion into the stream along with the flash flood. The alkalinity and pH values of the stream were high during winter (36.45 $\pm$ 3.49 ppm and 8.0 $\pm$ 0.21 respectively), which can be correlated with the high growth of algae during this period. The lowest values were recorded obviously in monsoon (25.25 $\pm$ 4.39ppm and 7.43 $\pm$ 0.18) due to rains being normally acidic in nature.

The quantitative study of periphytic algae indicated that it was observed seasonally maximum (124.0 $\pm$ 11.30 units/cm^2) in winter and minimum (24.0 $\pm$ 41.57 units/cm^2)in monsoon. The algal biomass was observed maximum 0.26 $\pm$ 0.03 mg/cm^2 (DW) and 0.126 $\pm$ 0.015 mgC/cm^2 (APDW) in winter and minimum 0.053 $\pm$ 0.092 mg/cm^2 (DW) and 0.026 $\pm$ 0.046 mgC/cm^2 (AFDW) in the monsoon. The detritus (standing stock) was observed maximum 13.96 $\pm$ 1.38 g DW/m^2 in winter and minimum 1.06 $\pm$ 1.84 g DW/m^2in monsoon 1996.

The algal biomass and detritus forms are important component of the stream ecology as the macrozoobenthos as well as fish feed on it. According to Welcomme (1985) in rhithronic waters where phytoplankton is virtually absent, the production of periphytic algae and submerged vegetation is very important. The longitudinal study of river indicated that the algal biomass was high at the lower spot (Dangal) of the stream (142 units/ cm^2, dry weight 0.3 mg/cm^2, and AFDW-0.14 mgC/cm^2) in relation to the upper spot (Thalisain-126 units/cm^2dry weight 0.26 mg/cm^2 and AFDW 0.14 mgC/cm^2).which can be correlated to the heterogeneity and stability of the substraum.

The detritus standing stock was also observed high at lower spot. i.e. (10.54 $\pm$ 6.33 g DW/m^2) at Dangal in comparison to the upper one i. e., (6.25 $\pm$ 4.39 gDW/m^2) Thalisain.

Qualitative study on the periphytic algae indicated that the algal carpet of periphytic algae was mostly of the *Cladophora ,Spirogyra, Ulothrix,Hydrodictyon, Zygnema* (all chlorophyceae) and the diatoms like *Synedra, Diatoma, Navicula, Cymbella, Tabellaria, Gomphonema, Fragilaria* and *Nitzschia*, etc. The detritus standing stock was contributed by the dried twigs and leaves of the riperian vegetation at the bank of stream, mainly the herbs, shrubs and trees of Quercus and Pinus etc. The fish observed in the stream were mainly the omnivore *(Tor tor, Tor putitora, Nemacheilus sps, Barilius sps.* etc) detritovore (*Tor chilinoides)* and the herbivore (*Garra sps, Crossocheilus sps*).

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Table 1: Seasonal variations in Physico-chemical Parameters of the Eastern Nayar during 1996. (Average of spot No.1 (Thalisain)and spot No.2(Satpuli)

Parameters	Season			
	Winter	**Summer**	**Monsoon**	**Autumn**
Water Temp (^{0}C)	11.45 ± 2.43	19.85 ± 4.67	24.07 ± 3.89	16.3 ± 5.44
Velocity (m/sec)	0.33 ± 0.059	0.40 ± 0.112	0.563 ± 0.194	0.33 ± 0.056
Turbidity (NTU)	7.7±1.79	9.90 ± 1.14	59.87 ± 42.96	22.4 ± 14.91
pH	8.0 ± 0.209	7.75 ± 0.104	7.43 ± 0.175	7.77 ± 0.233
Total Hardness (PPM)	75.23 ± 1.62	69.48 ± 4.36	72.25 ± 9.99	73.32 ± 2.57
DO (ppm)	11.35 ± 0.33	10.55 ± 0.28	9.15 ± 0.72	10.62 ± 0.28
Free CO_2 (ppm)	NIL	NIL	1.43 ± 0.79	0.085 ± 0.134
Total Alkalinity (ppm)	36.45 ± 3.49	31.8 ± 5.07	25.52 ± 4.39	35.75 ± 4.08
Nitrates (ppm)	0.037 ± 0.004	0.048 ± 0.015	0.073 ± 0.010	0.055 ± 0.008
Phosphates (ppm)	0.024 ± 0.005	0.030 ± 0.007	0.041 ± 0.009	0.037 ± 0.004

Table 2: Seasonal values of Periphytic algae and its biomass, and Detrius (Standing stock) in g DW/m2 in the upper stretches of Eastern Nayar during 1996.

Season	Periphytic Algae	Bio-mass		Seasonal value of detritus standingstock
	Units/cm2	Dry-weight mg/cm2	AFDW mgC/cm2	gDW/m
Winter	124.00±11.30	0.20± 0.03	0.126± 0.002	13.96± 1.38
Summer	92.67± 11.5	0.19 ±0.02	0.096± 0.011	7.29± 2.3
Monsoon	24.00± 41.57	0.053± 0.092	0.026± 0.046	1.06± 1.84
Autumn	62.00± 33.87	0.133± 0.068	0.067± 0.038	11.27± 2.20

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A study of ambient air quality and noise pollution in Nainital city

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Abstract

Nainital is a hill tourist place. It is famous for its natural beauty. Therefore, thousands of tourists from all over India and abroad come to visit this place. The environment of Nainital is fragile and sensitive, so it was intended to study the ambient air quality of the city. The present study includes the evaluation of ambient air quality and noise level. Ambient air monitoring has been conducted for suspended particulate matters, sulphur di-oxides and oxides of nitrogen at mall road (near Nagar Palika Library) and bus station (Tallital). The noise level monitoring was also conducted at different points of the city characterising commercial, residential area and silence zone. At other sites of silence zone, the values were usually beyond the prescribed limit. At all sites taken in commercial, areas, the values were beyond prescribed limit. The main sources of noise pollution in the city of Nainital is vehicular movements and the noise generated due to the use of horns of the vehicles. Similarly, the vehicular emissions are cause of air pollution. The SPM value at Nainital ranged from 88 to 366 $\mu g/m^3$, sulphur dioxide remained in the range of 10.2 to 25$\mu g/m^3$ and NO_x ranged between 13 and 86 $\mu g/m^3$. The study revealed that the SPM and NO_x are beyond the limit prescribed for sensitive areas.

Keyword :- Ambient, Leq, L Avg, SPM and Silence Zone

Introduction

Nainital is the head quarter of Kumaon division and location of many academic institutions. It is located at 1938 meter above mean sea level in between 29^0 24'N latitude and $79^0$28'E longitude. It is a major tourist resort mainly due to its geographical location and natural beauty. In the heart of the city, Nainital lake further enhances the beauty of the place and therefore, thousands of tourists from far distances are attracted every year. Roadways bus stand and taxi stands are situated at Tallital from where only light vehicles like two wheelers and four wheelers(taxi,

car,jeeps) pass through the Mall road to Mallital. Mall road is the main road of the Nainital city where several shopping complexes and Hotels are situated. Within five kilometers radius, in a cup shaped valley, a number of renowned schools, university campus, courts, a Zoo, hospitals, offices and residential areas are situated on the hills around Nainital lake. All these activities alongwith heavy traffic increases the sound pressure level of the city to a great extent.

A number of studies on ambient Air quality and noise pollution have been performed at various cities in India (Pandey 1992, Shastry *et al.* 1996, Ram Chandran *et al.* 1997, Tondon and Pandey 1998 and Edison *et al.* 1999). However,no such study is available form imporant city like Nainital. Therefore, in order to fill in the gap of knowledge and providing valuable database for the city of Nainital, the present study has been performed from April,2001 to June, 2001.

Material and methods

The present study includes :-

(i) Monitoring of sound Pressure level at various place in Nainital city.

(ii) Monitoring of ambient air quality such as SPM, RSPM, SO_2 and NO_x at a number of place at Nainital city.

1) Sound Perssure level was monitored during day time in "A" weightage using a sound pressure level meter, make Quest technology Model No. 1900 (U.S.A). It is highly sensitive instrument with computer added programes. The values have been recorded in the form of LMax., L Min., L Avg. etc.

Noise level monitoring was conducted at different points of city characterizing as commercial, residential area and silence zone which cover following places.

(I) Commercial area

a)**Tallital Road ways bus stand :** Tallital is the place where Roadways bus stand and private taxi stand are located. For noise monitoring this place was selected to assess the exposure of traffics noise.

b)**Near Shalimar Hotel :** Most of the hotels of Nainital are located on the Mall road, the main road of the city. Shalimar hotel is one of them. Main sources of noise is vehicular movements on the Mall road.

c)**Near Jama Masjid :** Jama Masjid is situated at Mallital where noise is created due to vehicular movements and human activities.`

d)**Mallital park :** It is situated behind the Naina Devi Temple, the Main temple of the Nainital city. Here, private buses, Taxies, Jeeps and two wheelers are parked.

(ii) Residential Area

(a)**Rajbhawan Campus** : Due to resricted number of visitors. It is supposed to be calm place. Its situation on hill top at height is also responsible for its being away from noisy activities.

(b)**Nainital Club** : A conference hall and a number of guest houses, flats and rooms are situated here. Owing to the human activities and vehicular movements, this place was selected for noise monitoring.

(c)**Aiyar Pata :** It is situated at height. However, the noise generated on the main road has its impact at this place.

(iii) Silence Zone

(a)**Nagar Palika Library Hall :** The library is located on Mall Road. This is characterized by the frequently use of horns by the vehicles moving on Mall road.This site was selected to assess the sound pressure level inside the reading hall of library.

(b)**Nagar Palika School :** This school is also situated on Mall Road. The noise here is generated mainly due to the vehicles.

(c)**Zoo :** The zoo is situated at height of above 2000 meter from mean sea level on top of hills towards Mall road. It is the most important tourist site.

In Nainital city, the main sources of Air Pollution is vehicular emissions and DJ Sets. Ambient air monitoring was conducted in front of Nagar Palika Library on Mall road and Tallital Bus/Taxi stand during day time for suspended particulate matter, Respirable suspended particulate matter, SO_2 and Oxides of nitrogen (NO_x) using a high volume sampler (Model 415) and Respirable dust sampler (Model 451) Envirotech make. Eight hourly samples for SPM, RSPM were collected using Glass fibre filter papers. Four houly gaseous samples for SO_2 and NO_x were also collected using absorbing media TCM (Tetra Chloro Mercurate) for SO_2 and O.1 N NaOH for NO_x. However, monitoring and analysis work was done as per methods of Central Pollution Control Board, New Delhi.

Results and Discussion

The ambient air quality standards with reference to noise and air set by Central pollution Control Board for different areas are given in Table-1. The ambient air quality data are presented in Table-2. The Sound pressure level values are given in Table-3.

During the monitoring period the values of SPM ranged from 88 to 366 $\mu g/m^{3,}$ RSPM observed between 66 to 106$\mu g/m^3$, Sulphur Dioxide (SO_2) varied between 10.2 to 25 $\mu g/m^3$ and Oxides of Nitrogen (NO_x) ranged between 13 to 86 $\mu g/m^3$. Higher values of SPM (366) and NO_x (86) were found during summer season. This may be attributed to the influx of tourists from far distances. Traditionally owing to the cold climate of the city the maximum number of visitors are attracted during summer months.

The table-2 shows that the SPM values were usually higher at Tallital. This may be due to maximum number of vehicles at this site. As per data of sound pressure level given in Table-3.

The sound pressure level in the Nainital city ranged between 31.6 dB (A) leq. at Rajbhawan Campus and 88.0 dB(A) leq. near Shalimar Hotel. Slightly higher values of average Noise level have been recorded as 90 dB (A) in New Delhi and 95 dB (A) in Bombay (Singh, 1984).

Environment Protection Act (1986) defines the silence zone as an area of 100 meter around hospitals, educational institutions, Courts, and eminent temples. However, in the present study, the zoo has been treated as a silence zone because the birds and wild animals are very sensitive to the noise. Many birds, for example leave the place when it becomes too noisy. There is a decrease in migratory birds to a place if it is subject to noise (Kudesia and Tiwari, 1994).

As far as the silence zone is concerned the sound presure level was recorded as 65.5 dB(A) leq. near Nagar Palika Nursery School, 57.8 dB (A) leq. at B.D. Pandey Hospital premises, 52.1 dB(A) leq. at zoo. Inside the Nagar Palika Library hall SPL ranged 41.7 to 76 dB(A) and average value obtained 56.2 dB(A) leq. Noise level in hospitals has been reported to range from 50 to 75 dB(A) by Singhal (2000) .All the values are above the limit of 50dB(A) leq.prescribed as silence zone.

Nagar Palika School is just close to the Mall road and exposed to the incessant noise generated by movement of the vehicles and use of pressure horns. The patients of B.D. Pandey Hospital are also bound to tolerate the higher level of noise. The hospital is also close to the road. Slightly lower values of SPL at zoo may be attributed to its situation and location at high altitude at the top of the hill. It is away from the main road and deviod of rush.

In Rajbhawan Campus, during the study the SPL values ranged between 31.6 to 78.9 dB(A) leq. The average of SPL values was obtained 50.3 dB(A) Leq. which is well within the limit prescribed for residential area. However, the values were usually higher 75.8 dB(A) Leq. at Nainital Club, the low value of SPL at Rajbhawan may be attributed to its situation/location and thick green belt cover around it. Restricted number of vehicles pass through this area. On the contrary the higher values at Nainital club are due to vehicular movement,use of pressure of horns and human activities.

At Tallital Bus stand, the SPL varied from a minimum 65.0 dB(A) to maximum 81.0dB, the average value of the SPL was recorded as 70.6 dB(A) leq. At another commercial area near Shalimar Hotel, the values of SPL ranged from 45.3 to 88.0 dB(A). The average values obtained near jama Masjid and Mallital park are 70.1 dB(A), and 80.4 dB(A) respectively. Sound pressure level at the residence of Mr. P. Pandey, Ayaar Pata observed 48.1 to 77.9 and average value was found as 55.6 which is slightly higher as compared to standard prescribed for residential area.

At all the selected sampling points, the average obtained at commercial & residential area values are beyond the limit of 65.0 dB(A) leq. prescribed for commercial area and 55 dB(A) leq prescribed for residential area respectively.

Blowing of pressure horns, movement of vehicles and human activities are responsible for the higher level SPL values at all the sites. The persons exposed to this level of noise pollution for long time may suffer the menace of noise pollution. It is obvious that the shop owners, office bearers and a number of worker stay there for very long period.

Rajbhawan and Zoo area may be assumed as the safe place as far a noise pollution is concerned. Hospital, School and Library like sensitive areas are subject to higher level of noise pollution.

Conclusion

Blowing of pressure horns, movement of unmaintained vehicles and DJ Sets are the main reasons for high noise level in Nainital city. Consequently, the patients in Hospitals and students in School/Colleges, Office bearers and shop owners are exposed to very high noise level. This will cause adverse health effects on patients and or aggravate their illness in Hospitals and students in school/colleges will also distracted from these high noise levels. Residential areas are not exceptional from the exposure to high noise levels.Thus, it is the duty of authorities to take the following necessary action to prevent this important city from the menace noise and air pollution.

1. Strict enforcement to ban the use of air horns inside the town.
2. Restrict the movement of vehicles inside the city of Nainital.
3. Prevent use of loudspeaker and bursting crackers.
4. DJ Sets should be provided with acoustic enclosures.
5. Use of loudspeakers on various occasions may be banned.

Table 1: The ambient air quality standards with reference to Noise and air

Standard in respect of Noise				Standards in respect of ambient air quality					
S.No.	Category of Area	Limits in dB(A) Leq.		S.No.	Category of Area	Parameters unit inmg/m^3			
		Day time	Night Time			SPM	RSPM	SO_2	NO_x
1.	Industrial Area	75	70	1.	Industrial Area	500	150	120	120
2.	Commercial Area	65	55	2.	Residential Area	200	100	80	80
3.	Residential Area	55	45	3.	Sensitive Area	100	75	30	30
4.	Silence Zone	50	40						

Note: (a) Day time is reckoned from 6 A.M. to 9 P.M.

(b) Night time is reckoned from 9 P.M. to 6 A.M.

(c) Silence zone is defined as areas upto 100 meters around premises as hospitals , Educational institutions , courts and eminent temples . Use of Vehicular horns, loudspeakers and bursting of crackers shall be banned in these zones

Table 2: Ambient air quality data at Nainital City

S.No.	Station	Month	SPM	RPM	SO_2	NO_x
1.	Tallital Bus Stand	April-2001	188	85	17	27
		May-2001	290	106	23	42
		June-2001	366	96	25	86
2.	Nagar Palika Library	April-2001	88	66	10.2	13
		May-2001	224	72	13	32
		June-2001	206	92	20	42

NOTE :- All values are In $\mu g/m^3$

RPM - Respirable Particulate Matter (<10 μm size)

Table 3: Values of Sound presure level at different places in the city of Nainital

S.No.	Sampling site	Category	Sound Pressure level dB(A) Leq.		
			L min.	L.Max.	L.Avg.
1.	Mall road- Hotel Shalimar	C	45.3	88.0	69.6
2.	Inside library hall (Nagar Palika library)	S	41.7	76.0	56.1
3.	Jama Masjid	C	50.5	85.8	70.1
4.	Mallital Parks	C	63.7	98.0	80.4
5.	Bus Stand-Tallital	C	65.0	81.0	70.6
6.	Nainital club	R	44.7	100.0	75.8
7.	Nagar Palika-Nursery School	S	52.6	76.4	65.5
8.	Rajbhawan	R	31.6	78.9	50.3
9.	Zoo-Inside the Zoo	S	37.2	68.1	48.3
10.	Zoo-at main gate	S	33.2	69.4	52.1
11.	B.D.Pandey hospital	S	50.1	98.2	57.8
12.	Ayar Pata- P.pandey	R	48.1	77.9	55.6

Note :- **C**-commercial area
R- Residential area
S- Silence Zone

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Histopathological study of neemax induced kidney of *Rasbora daniconius*

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Abstract

Neem Indian lilac, *Azadirecta Indica* is renewable resource of various useful product. Today it is being used in a variety of products, such as in the field of Agriculture, Medicine, toileteries, cosmetics livestock, production and health etc. Acute toxicity of neemseed powder(Neemax) was studied using fresh water fish *Rasbora daniconius*. Excess amount of Neemax showed acute toxicity on the various organ of fish liver, gills and kidney.

Key Words:- Neemax ,Kidney,Azadirecta

Introduction

Neem (*Azadirecta indica)* native of Indian subcontinent is a highly esteemed tree for the people in the region for centuries its derivatives have found used in agriculture, etc. Although uses of neem tree in India as a wonder drug is traced as far back as 4500 years ago. Fresh water fish *Rasbora daniconius* is native of Indian subcontinent, it is fresh water fish. The kidney of *Rasbora* is a glomerulas kidney and confirms in many respects to the general teleostean pattern. Nephron comprising of-

(i) Renal corpuscles with glomerules
(ii) Ciliated neck segment
(iii) Initial proximal segment
(iv) Second proximal segment
(v) Distal segment and collecting tubules.

Ali and Salih (1982) reported haemorrhagic erosions and degeneration of liver, kidney etc. in sheep by using (*Azadirecta indica*). Bhide *et al.* (1958) reported degeneration of kidney of puppies Kanungo (1996) include degeneration changes in kidney of poultry birds.Until last two decades histopathological studies were limited to light microscopic techniques but by using electron microscopes workers are able to study histopathology of these organs (Leino *et al.*, 1990; Hemelrat *et al*., 1990; Fisher-Schesl *et al*., 1991; Sateesh, 1997; Rao, 1998; Nayak, 2001) have investigated pathological lesion in kidney at ultrastructural level.

Material And Method

The fish *Rasbora daniconius* were collected from unpolluted upstream river Betwa (Vidisha) the fish were acclamatized in collapsible plastic pool for one week under laboratory conditions with normal feeding.The neem seed powder Neemax manufactured by Ecomax Agro System Ltd. Mumbai was used for the study. Stock solution was prepared by soaking desirable quantity of Neemax in water for three hours then it was filtered through cotton cloth and filtratin. Series of concentration were prepared by adding stock solution in ten litres of water (APHA 1985). Fresh stock solution was prepared for every set of bioassay test and experiments for ultrastructural study. The acute toxicity of Neemax was tested by 96 hours static bioassay tests. Fish of similar size were selected for one set of experiments. Dead fish were removed from aquaria immediately. Mortality were recorded after 24,48,72and 96 hrs duration.Screening test were conducted prior conducting full scale toxicity tests.The surface ultrastructure of fill of control and Neemax expose fish was studied by scanning Electron microscopy. Ultra structural study was undertaken by Transmission Electron Microscopy to observe cellular and sub cellular alterations in kidney of Neemax exposed fish.

Results and Discussion

Pathological lesions were studied in the renal tubule of fish after one week exposure of neem seed powder. Numerous mitochondria were observed in both initial proximal segment and II proximal segment (fig. 1,2). But in mitochondria crystal were not clearily observed,at some places empty spaces were same in the cytoplasm of kidney tubules indicating beginning of degenerating process (fig. 1,2). In a cell of secondary proximal tubule concentric lamillac of RER were seen around electron dense material and increased intensity of SER was observed.

The initial proximal segment have been characterised by the presence of microvilli in the increasing surface area of tubular cells for re-absorption.

After exposure of neem number of mitochondria was found increased in some cells of renal tubule along with proliferation of RER the present study reveals that exposure of toxicants such as neemax causes serval damage to the kidney of fish and such damage is almost irrepairable.

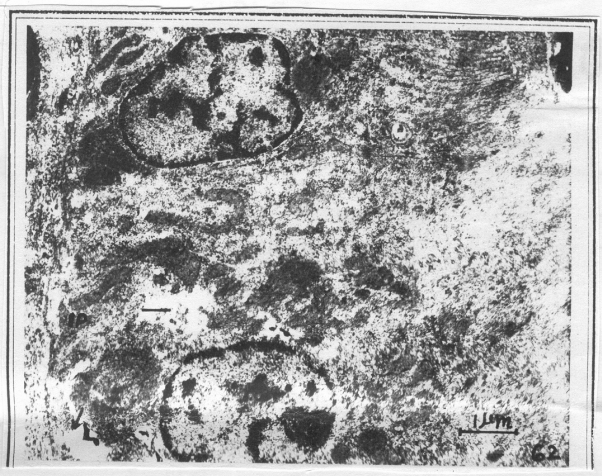

Fig. 1 TEM of initial proximal segment of nephron of one week neem exposed fish showing empty spaces indicating degeneration (Arrows).

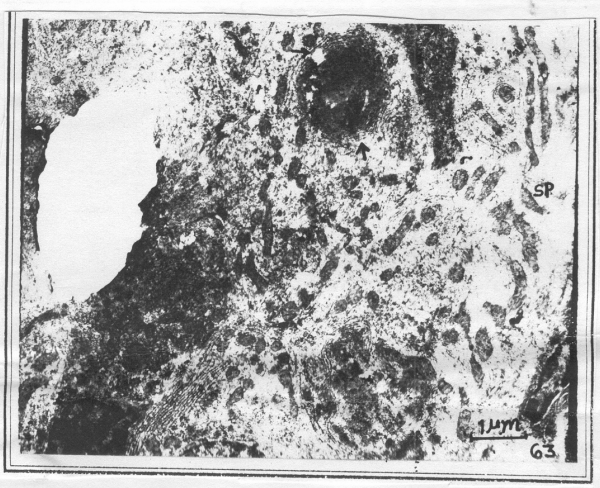

Fig. 2 TEM of second proximal segment (SP) of nephron of one week neem treated fish showing concentric lamellar formation of RER (Arrow).

Table 1: Mortality and percentage mortality of *Rasbora daniconius* in different concentration of Neem seed Powder-Nemas after different exposure durations temperature 30 ± 2 ^{0} C

No. of Fishes	Concentrations mg/lts.	Exposure durations			
		24 hrs.	48 hrs.	72 hrs.	96 hrs.
30	600	Nil	Nil	Nil	Nil
30	700	Nil	Nil	Nil	6 (20 %)
30	800	6 (20 %)	6 (20 %)	6 (20 %)	12 (40%)
30	1000	12 (40%)	12 (40%)	12 (40%)	12 (40%)
30	1200	12 (40%)	18 (60 %)	18 (60%)	18 (60%)
30	1300	12 (40%)	18 (60%)	18 (60%)	24 (80%)
30	1400	18 (60%)	24 (80%)	24 (80%)	30 (100%)
30	1500	24 (80 %)	24 (80%)	30 (100%)	30 (100%)
30	2000	30 (100%)	30 (100%)	30 (100%)	30 (100%)

Table 2: Acute toxicity 96 Hrs. LC_{50} of neem based products to fish species with mean values and calculated values of Azadirachtin content

Test Chemical	Toxicity 96 hrs. mg/lts LC 50 mean S.E.	Calculated Azadiractin content mg/l	No. of test fish species	Change of LC 50 (%) 24 to 96 hrs.
AZA Azadiractin (49% AZA 51%ONC)	>4	1.96	1	0
AZT,Azatin TMEC (3% AZA-27,ONC, 70% AZT-A)	>4±0.4	0.12	3	39
NEX, Neem Extract(23% AZA, 77% ONC)	7±3	1.61	3	34
MAR, MargosanO (0.3% AZA-12%, ONC 87.71% MARB, 72.6%)	33±3	0.09	3	41
PHE,Pherotech 4.6%, AZA 15% ONC, 70.4%PHE-C)	72±6	3.312	3	22

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Rain water harvesting

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Introduction

As we all know that about 70 percent of the earth is water but most part of the earth is ocean. Only 3% of total water available on earth is fresh water. Out of the three percent, only 1 percent is accessible as surface fresh water where as the rest 2 percent is locked away in the form of ice caps and glaciers in the polar regions. 1 percent water is regularly renewed by rain fall and other means and thus available on a sustainable basis and easily considered accessible for human use.

Increasing population together with the intensifying urbanization and industrialization affects availability of fresh water both qualitatively and quantitatively. Water is clearly the single largest problem facing India today, though the country was once upon a time categorized as a water rich society because of non-uniform distribution of rainfall.Over the years about 90 percent of its annual rainfall occurs during the summer monsoon i.e. from the July to September whereas the rest of the months the country get less rainfall. Even India is wettest but still there is water scarcity. Water scarcity will be one of the major threats to humankind during this century (Prinz 2000). The problem of water shortage in arid and semi-arid regions is low rainfall and uneven distribution through out the season, which makes rain fed agriculture a risky enterprise.

There were lot of methods which were applied by ancient people, as the available water resources taken from streams, rivers and ground water will not be sufficient in most dry areas to cover the needs of agriculture and urban areas, we have to reassess the value of certain traditional irrigation methods, to find out their value to ease future water scarcity (Prinz and Singh 2000).These traditional methods played a much greater role in the past and were the backbone of ancient civilization in arid and semi-arid areas around the world (Agarwal & Narain 1997, Prinz 1996). Therefore new interest came up in recent decades to evaluate traditional water management techniques (Prinz *et al*.1999) most of them being simple, sure to implement and of low capital investment. The classical sources of irrigation water are often at the break of overuse and therfore untapped sources of (irrigation) water have to be sought for increasing agricultural

productivity and providing sustained economic base. Water harvesting for dry-land agriculture is a traditional water management technology to ease future water scarcity in many arid and semi-arid regions of world.

Older Concept

The Indus Valley Civilization, that flourished along the banks of the river Indus and other parts of western and northen India about 5,000 years ago, had one of the most sophisticated urban water supply and sewage systems in the world. The fact that the people were well acquainted with hygiene can be seen from the covered drains running beneath the streets of the ruins at both Mohenjodaro and Harappa. Another very good example is the well-planned city of Dholavira, on Khadir Bet, a low plateau in the Rann in Gujarat. One of the oldest water harvesting systems is found about 130 km from Pune along Naneghat in the Western Ghats. A large number of tanks were cut in the rocks to provide drinking water to tradesman who used to travel along this ancient trade route. Each fort in the area had its own water harvesting and storage system in the form of rockcut cisterns, ponds, tanks and wells that are still in use today. A large number of forts like Raigarh had tanks that supplied water.

In ancient times, houses in parts of western Rajasthan were built so that each had a rooftop water harvesting system. Rainwater from these rooftops was directed into underground tanks. This system can be seen even today in all forts, palaces and houses of the region.

Underground baked earthen pipes and tunnels to maintain the flow of water and to transport it to distant places, are still functional at Burhanpur in Madhya Pradesh, Golkunda and Bijapur in Karnataka, and Aurangabad in Maharashtra.

Traditional Method

Traditional rainwater harvesting, which is still prevalent in rural areas, was done in surface storage bodies like lakes, ponds, irrigation tanks, temple tanks etc. In urban areas, due to shrinking of open spaces, rainwater will have to necessarily be harvested as ground water, hence harvesting in such places will depend very much on the nature of the soil viz. clayey, sandy etc. The below listed are the various kinds of traditional rainwater harvesting methods.

1. Kunds

In the sandier tracts, the villagers of the Thar Desert had evolved an ingenious system of rainwater harvesting known as kunds or kundis. The first known construction of a kund in western

Rajasthan was during 1607 AD by one Raja Sursingh in village Vadi-ka-Melan. In the Mehrangarh Fort in Jodhpur. Kund, the local name given to a covered underground tank, was developed primarily for tackling drinking water problems. Usually constructed with local materials or cement. Kunds were more prevalant in the western arid regions of Rajasthan, and in areas where the limited groundwater available was moderate to highly saline. Groundwater in Barmer, for instance, nearly 76 percent of the district's area,has total dissolved salts (TDS) ranging from 1,500-10,000 parts per millon (ppm).Under such conditions kunds provided convenient, clean and sweet water for drinking. Kunds were owned by communities or privately, which the rich having one or more kunds of their own. Community kunds were built through village co-operation or by a rich man for the entire community. The kund consists of a saucer-shaped catchments area with a gentle slope towards the center where a tank is situated. Openings or inlets for water to go into the tank are usually guarded by a wire mesh to prevent the entry of floating debris, birds and reptiles. The top is usually covered with a lid from where water can be drawn out with a bucket. Kunds are large cicular in shape with little variation between the depth and diameter which ranges from 3-4.5 m. Lime plaster or cement is typically used for the construction of the tank, since stone as a building material is not always available and is relatively more expensive. Either of these material can be used to plaster the horizontal and vertical soil surfaces, although cement ensures a longer life span. The success of a kund depends on the selection of the site, particularly its cathments characteristics. An adequately large catchments area has to be selected or artificially prepared to produce adequate runoff to meet the storage requirements of the kund.

2. Kul Irrigation Method

Spiti is an important trading post on the route connecting Ladakh and the plains of Himachal Pradesh. Villages in the Spiti subdivision are located between 3,000 m and 4,000 m, which means they are snowbound six months a year. Rainfall is negligible in spiti because it is a rain shadow area. Spiti's lunar-like terrain was transformed into an agrarian success story by an ingenious system, devised centuries ago to tap distant glaciers for water. But shortsighted developmental policies, though well-intentioned, now threaten both this unique irrigation system and the social conciousness that spawned it. The soil is dry and lacks organic matter. But, despite these handicaps, the spiti valley has been made habitable and productive by human ingenuity. But spiti's unique contribution to farming is kul irrigation, which utilises kuls (diversion channels) to carry water from glacier to village. The kuls often span long distances, running down precipitous mountain slopes and across crags and crevices. Some kuls are 10 km long, and have existed for

centuries. The crucial portion of a kul is its head at the glacier, which is to be tapped. The head must be kept free of debris, and so the kul is lined with stones to prevent clogging and seepage. In village,the kul leads to a circular tank from which the flow of water can be regulated. For example, when there is need to irrigate, water is let out of the tank in a trickle. Water from the kul is collected through the night and released into the exit channel in the morning. By evening, the tank is pratically empty, and the exit is closed. This cycle is repeated daily. The culture also is instrumental in maintaining the carrying capacity of the surrounding cultivable land. However, this system, carefully nurtured through the centuries, now runs the risk of being upset through government intervention.

3. Bamboo Rainwater Harvesting

In Meghalaya an ingenious system of tapping of stream and spring water by using bamboo pipes to irrigate plantations is widely prevalent. It is so perfected that about 18-20 litres of water entering the bamboo pipe system per minute gets transported over several hundred meters and finally gets reduced to 20-80 drops per minute at the site of the plant. The tribal farmers of Khasi and Jaintia hills use the 200-year-old system. The bamboo drip irrigation system is normally used to irrigate the betel leaf or black pepper crops planted in areca nut orchards or in mixed orchards. Bamboo pipes are used to divert perennial springs on the hilltops to the lower reaches by gravity. The channel sections, made of bamboo, divert and convey water to the plot site where itis distributed without leakage into branches, again made and laid out with different forms of bamboo pipes. Manipulating the intake pipe positions also controls the flow of water into the lateral pipes. Reduced channel sections and diversion units are used at the last stage of water application. The last channel section enables the water to be dropped near the roots of the plant.Bamboos of varying diameters are used for laying the channels. About a third of the outer casing in length and internodes of bamboo pieces have to be removed while fabricating the system. Later, the bamboo channel is smoothened by using a dao, a type of local axe which is a round chisel fitted with a long handle. Other components are small pipes and channels of varying sizes used for diversion and distribution of water from the main channel. About four to five stages of distribution are involved from the point of the water diversion to the application point.

4. Temple tank

People in ancient time used to store water in temples and other religious places, this was another method for storing water.

As the appropriate choice of technique depends on the amount of rainfall and its distribution, land topography, soil type and soil depth and local socio-economic factors,these systems tend to be very site specific. The water harvesting methods applied strongly depend on local conditions and include such widely differing practices as bunding, pitting, micro catchments water harvesting, flood water and ground water harvesting (Prinz 1996, Critchley and Siegert 1991).

"*the 9th IRCSC (International Rainwater Catchement System Conference), held in Brazil in July 1999,Dr. A.Appan said:*

"The concept of rainwater catchment system technology is as old as the mountains. The standard adage- as in all water supply schemes is- store water (in a tank reservoir) during the rainy season so that you can use it when you need it most during the summer. In other words 'Save for the dry day!' The principle, methods of construction, usage and maintenance are all available. And, most important of all, there are many financial models to suit developing and developed countries. What is most needed is the moral acceptance of the technology and the political will to implement the system."

A non-conventional approach that is gaining significance as an effective long term strategy for supplementing traditional sources of freshwater supplies is the harvesting and utilization of rain water.

Water Harvesting

Suface water is inadequate to meet our demand and we have to depend on ground water.Due to rapid urbanization, infiltration of rainwater into the sub-soil has decreased drastically and recharging of ground water has diminished. Under such circumstances conservation of water by improved technology based on traditional concept has become the need of the hour.

Types of water harvesting

A brief description of these water-harvesting techniques along with sub-types is given below:

1.**Rainwater harvesting:** Rainwater harvesting is defined as a method for inducing, collecting, storing and conserving local surface runoff for agriculture in arid and semi-arid regions (Boers and Ben-Asher 1982). Rainwater harvesting covers three types of water harvesting.

* Water collected from roof tops, courtyards and similar compacted or treated surfaces is used for domestic purpose or garden crops.

* Microcatchment water harvesting is a method of collecting surface runoff (sheet or rill flow) from a small catchment area and storing it in the root zone of an adjacent infiltraion basin. The basin is planted with a single tree or bush or with annual crops (Prinz 2001).

* Macrocatchment water harvesting is also called " Water harvesting from long slopes" or "harvesting from external catchment systems" (Pacey and Cullis 1988). In this case, the runoff from hillslope catchments is conveyed to the cropping area, which is located below the hill foot on flat terrain.

2. Flood water harvesting: Can be defined as the collection and storage of creek flow for irrigation use. Flood water harvesting, also known as 'large catchment water harvesting' or 'Spate Irrigation', may be classified into following two forms:

*** Floodwater harvesting within stream bed:** In this case the water flow is dammed and as a result, inundates the valley bottom of the flood plain. The water is forced to infiltrate and the wetted area can be used for agriculture or pasture improvement.

*** Floodwater diversion:** In this case the wadi water is forced to leave its natural course and conveyed to nearby cropping fields.

It is difficult to give exact figure on the present area under various forms of floodwater harvesting system. Pakistan has more than 1.5 millon ha under floodwater harvesting. Such method of floodwater harvesting is adopted in countries of North Africa and Middle East regions.

3. Groundwater harvesting: It is a rather new term and employed to cover traditional as well as uncoventional ways of ground water extraction. Qanat system, underground dams and special types of wells are few examples of the groundwater harvesting techniques.

Qanats, widely used in Iran, Pakistan, North Africa and Spain consists of a horizontal tunnel that taps underground water in an alluvial fan, brings it to the surface due to gravitational effect. Qanat tunnels have an inclination of 1-2% and a length of up to 30 km. Many are still maintained and deliver steadily water to fields for agriculture production and villages for drinking water supply.

Groundwater dams like ' Subsurface Dams' and ' Sand Storage Dams' are other fine example of groundwater harvesting. They obstruct the flow of streams in a river bed there by water is stored in the sediment below ground surface and can be used for aquifer recharge. Sand filled reservoirs have the following advantages:

* Evaporation losses are reduced.

* No reduction in storage volume due to siltation.

* Health hazards due to mosquito breeding are avoided.

Groundwater harvesting does not play the same role globally as rain and floodwater harvesting.

4. Underground Storage

As several disadvantages are connected with surface storage of water-large evaporation losses, loss of storage caused by siltation, pollution problems and loss of agricultural land, underground storage of water may be an interesting alternative. This storage can be done in near surface aquifers (e.g. in wadi beds), calling for a conjunctive management of water resources, or in cisterns.Cisterns are man-made caves or underground constructions to store water. Often the walls of these cistern are plastered, their water losses by deep percolation or by evaporation can be minimal. The construction of cisterns was already practiced several thousand years ago.

Traditionally, in Mediterranean houses, one cellar room was specifically designed to store rain-water. Similar in-house cisterns are known from Rajasthan, NW India. In the same region, 'Kunds', covered underground tanks with a plastered catchment, are found (Agarwal and Narain 1997). Now a days cisterns are often constructed using concrete.

Modern Methods for rain water harvesting

The Modern methods of rainwater harvesting are categorised under two, they are Artifical Re-charging and Rain Water Harvesting.The former is classified into Absorption Pit Method, Ab-sorption Well Method, Well cum Bore Method and Recharge trench cum injection well. The later is categorised into Individual Houses and Grouped Houses which are further classified into Percolation Pit Method, Bore Well with Settlement Tank, Open Well Method with filter bed Sump and Percolation Pit with Bore Method. In the Indian region over the last few millennia, such climate fluctuations may have given rise to traditional village tanks, ponds and earthern embank-ments numbering more than 1.5 million, that still harvest rainwater in 660,000 villages in India (Pandey 2001).

Artificial Recharging

1. Absorption Pit Method
2. Absorption Well Method

3. Well cum Bore Method

4. Recharge trench cum injection well

1. Absorption Pit Method

A percolation/absorption pit is a hand bore made in the soil with the help of an augur and filled up with pebbles and river sand on top. The depth of these pits will be anywhere between 4 and 8 meters depending on the nature of the soil. If the soil is clayey, the pit has to be dug to a depth till a reasonable sandy stratum is reached. The diameter of these pits will be 25 cm (10 inches). A square/ circular collection chamber with silt arrester is provided at the top.

2. Absorption Well Method

These wells are constructed using cement rings readily available in the market. The diameter of these rings range from 2ft. to 6 ft. The depth up to which these wells are dug depends on the nature of the soil and the diameter depends on the number of roof top pipes that are likely to be connected to each one of these wells. These wells are left unfilled and are covered with RCC slabs of suitable thickness to facilitate free pedestrian and vehicular movement on the ground.

3. Well cum Bore Method

In areas where the soil is likely to be clayey up to say 15ft. and more, it is advisable to go in for a percolation well up to 10ft. or 15ft. and a hand bore pit within this well up to a depth of 10ft.to 15ft. from its bottom. A PVC pipe of 5inch diameter is inserted into the bore for the entire length.

4. Recharge trench cum injection well

This technique is ideally suited for areas where permeable sandy horizons within 3 to 5m. below ground level and continues up to the water level under unconfined conditions, by which copious water available can be easily recharged.

In this technique, 1 to 2m. wide and 2 to 3m. deep trench is excavated, the length of which depends on the site availability and volume of water to be handled. An injection,well of 100 to 150 mm diameter is constructed, piercing through the layers of impermeable horizons to the potential aquifer reaching about 3 to 5 meters below water levels (1 to 10m.)from the bottom of the trenches. Depending upon the volume of water to be injected, the number of injection wells can be increased to enhance the recharging rate.

Rainwater harvesting

Rainwater can be harvested from the following surfaces

Rooftops: If buildings with impervious roofs are already in place, the catchment area is effectively available free of charge and they provide a supply at the point of consumption. Paved and unpaved area i.e., landscapes, open fields, parks,storm water drains, roads and pavements and other open areas can be effectively used to harvest the runoff. The main advantage in using ground as collecting surface is that water can be collected from a larger area. This is particularly advantageous in area of low rainfall.

Waterbodies: The potential of lakes, tanks and ponds to store rainwater is immense. The harvested rainwater can not only be used to meet water requirements of the city, it also recharges groundwater aquifers.

Stormwater drains: Most of the residential colonies have proper network of stormwater drains. If maintained neatly, these offer a simple and cost effective means for harvesting rainwater.

Recharge structures

Rainwater may be charged into the groundwater aquifers through any suitable structures like dugwells, borewells, recharge trenches and recharge pits.

Various recharge structures are possible which promotes the percolation of water through soil strata at shallower depth (e.g. recharge trenches, permeable pavements) whereas others conduct water to greater depths from where it joins the groundwater (e.g. recharge well). At many locations,existing structures like wells, pits and tanks can be modified as recharge structures, eliminating the need to construct any structures afresh. Here are a few commonly used recharging methods.

1. Recharging of dugwells and abandoned tubewells

In alluvial and hard rock areas, there are thousands of wells which have either gone dry or whose water levels have declined considerably. These can be recharged directly with rooftop run-off. Rainwater that is collected on the rooftop of the building is diverted by drainpipes to a settlement or filtration tank from which it flows into the recharge well (borewell or dugwell).

If a dugwell is used for recharge, the well lining should have openings (weep-holes) at regular intervals to allow seepage of water through the sides. Dugwells should be covered to prevent

mosquito breeding and entry of leaves and debris. The bottom of recharge wells should be desilted annually to maintain the intake capacity.

Providing the following elements in the system can ensure the quality of water entering the recharge wells:

1. Filter mesh at entrance point of rooftop drains

2. Settlement chamber

3. Filter bed

2. Settlement tank

Settlement tanks are used to remove silt and other floating impurities from rainwater. A settlement tank is like an ordinary storage container having provisions for inflow (bringing water from the catchment), outflow (carrying water to the recharge well) and overflow. A settlement tank can have an unpaved bottom surface to allow standing water to percolate into the soil.

In case of excess rainfall, the rate of recharge, especially of borewells, may not match the rate of rainfall. In such situations, the desilting chamber holds the excess amount of water till it is soaked up by the recharge structure. Thus, the settlement chamber acts like a buffer in the system.

Any container (masonry or concrete underground tanks, old unused tanks, pre-fabricated PVC or ferro-cement tanks) with adequate capacity of storage can be used as a settlement tank.

3. Recharging of service tubewells

In this case the rooftop runoff is not directly led into the service tubewells, to avoid chances of contamination of groundwater. Instead rainwater is collected in a recharge well, which is a temporary storage tank (located near the service tubewell), with a borehold ,which is shallower than the water table. This borehole has to be provided with a casing pipe to prevent the caving of soil, if the strata is loose. A filter chamber comprising of sand, gravel and boulders is provided to arrest the impurities.

4. Recharge pits

A recharge pit is 1.5m to 3m wide and 2m to 3m deep. The excavated pit is lined with a brick/stone wall with openings (weep-holes) at regular intervals. The top area of the pit can be covered with a perforated cover. Design procedure is the same as that of a settlement tank.

5. Soakaways/Percolation pit

Percolation pits, one of the easiest and most effective means of harvesting rainwater, are generally not more than 60x 60x 60 cm pits, (designed on the basis of expected runoff as described for settlement tanks), filled with pebbles or brick jelly and river sand, covered with perforated concrete slabs wherever necessary.

6. Recharge trenches

A recharge trench is a continuous trench excavated in the ground and refilled with porous media like pebbles, boulders or broken bricks. A recharge trench can be 0.5 m to 1 m wide and 1 m to 1.5 m deep. The length of the recharge trench is decided as per the amount of runoff expected. The recharge trench should be periodically cleaned of accumulated debris to maintain the intake capacity. In terms of recharge rates, recharge trenches are relatively less effective since the soil strata at depth of about 1.5 meters is generally less permeable. For recharging through recharge trenches, fewer precautions have to be taken to maintain the quality of the rainfall runoff. Runoff from both paved and unpaved catchments can be tapped.

7. Recharge troughs

To collect the runoff from paved or unpaved areas draining out of a compond, recharge troughs are commonly placed at the entrance of a residential/Instutional complex. These structure are similar to recharge trenches except for the fact that the excavated portion is not filled with filter materials. In order to facilitate speedy recharge, boreholes are drilled at regular intervals in this trench. In design part, there is no need of incorporating the influence of filter materials.

This structure is capable of harvesting only a limited amount of runoff because of the limitation with regard to size.

8. Modified injection well

In this method water is not pumped into the aquifer but allowed to percolate through a filter bed, which comprises sand and gravel. A modified injection well is generally a borehole, 500 mm diameter, which is drilled to the desired depth depending upon the geological conditions, perferably 2 to 3 m below the water table in the area. Inside this hole a slotted casing pipe of 200mm diameter is inserted. The annular space between the borehole and the pipe is filled with gravel and developed with a compressor till it gives clear water. To stop the suspended solids from entering the recharge tubewell, a filter mechanism is provided at the top.

Diversion of run off into existing surface water bodies

Construction activity in and around the city is resulting in the drying up of water bodies and reclamation of those tanks for conversion into plots for houses. Free flow of storm run off into these tanks and water bodies must be ensured. The storm run off may be diverted into nearest tanks or depression, which will create additional recharge.

Formula used for potential of harvested water

Water harvesting potential =Rainfall (mm) x Area of catchment x Runoff coefficient

Benefits of Rainwater Harvesting

Development and augmentation of freshwater supplies through installation of Rain water harvesting systems will offer following benefits:

(1)It provides relatively high quality water, soft and low in minerals at low cost

(2)Direct capturing of rain water significantly reduces our reliance on water from dams/ reservoirs and canal systems. This will exert less pressure on national storage capacity at marco level and can reduce the need to expand dams or build new ones

(3)Rainwater harvesting promotes self-sufficiency and fosters an appreciation for water as a resource. It also promotes water conservation.

(4)Local erosion and flooding from imprevious cover associated with buildings is lessened as a portion of local rainfall is diverted into collection tanks.

(5)Encourages households and institutions to be well equipped with an onsite and decentralized water supply of reliable quality.

Disadvantages

The technical progress of the 19th and 20th century occurred mostly in the so called developed countries in moisture moderate climate zones without a need for rainwater harvesting. Further more emphasis was put on big dams, groundwater development and piped irrigation projects with high input of fossil energy and electricity, this was another reason that rainwater-harvesting techniques have been set aside or totally forgotten. The technical progress of the 19th and 20th century occurred mostly in the so called developed countries in moisture moderate climate zones without a need for rainwater harvesting. As a consequence of colonialization agricultural prac-

tices from moderate climate zones were implanted in drier climate zones.Short comings of rainwater harvesting technologies are mainly due to the limited supply and uncertainty of rainfall. Adoption of this technology requires a bottom up approach rather than the more usual top dowm approach employed in other water resources development projects. This may make rainwater harvesting less attractive to some governmental agencies tasked with providing water supplies in developing countries, but the mobilization of local government and NGO resources can serve the same basic role in the development of rainwater-based schemes as water resources development agencies in the larger, more traditional public water supply schemes.

Conclusion

Rainwater harvesting has the potential to increase the productivity of arable and grazing land by increasing the yields and by reducing the risk of crop failure. They also facilitate re/or afforestation, fruit tree planting or agroforestry. With regard to tree establishment, rainwater harvesting can contribute to the fight against desertification. Water harvesting technology is especially relevant to the semi-arid and arid areas where the problems of environmental degradation, drought and population pressures are most evident. It is an important component of the package of remedies for these problem zones. Most of techniques are relatively cheap and can therefore be a viable alternative where irrigation water from other sources is not readily available or too costly. Unlike pumping water, water harvesting saves energy and maintenance costs. Using harvested rainwater helps in decreasing the use of other valuable water sources like groundwater, there is no doubt that implementation of water harvesting techniques will expand. Remote sensing and Geographical Information Systems can help in the determination of areas suitable for water harvesting (Prinz *et al.* 1998).

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Ganges water pollution and its management through religion

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Abstract

The Ganges, a major river of the Indian subcontinent, associated with myth and reality of people, is becoming polluted on its way down to the Indian Ocean. The pollution starts from the beginning itself but the prominent cities which are adding substantially to the woes of the Ganges are Kanpur., Allahabad, Varanasi, Patna and Calcutta. The major polluting industries are the leather industries that use large amounts of Chromium and other chemicals, and much of it finds its way into the meager flow of the Ganges Besides , a large volume of waste-estimated at nearly 1 billion liters of mostly untreated raw sewage is dumped in the river per day. Also inadequate cremation procedures contribute to a large of partially burnt or unburnt, corpse floating down the Ganga, not to mention livestock corpses. The 'Ganges Action Plan' was set up which formed a number of waste treatment plants and most of the work was limited to monitoring of the various parameters of the water from time to time. But today, there is an urgent need of arousing the religious sentiments of the people of the region who have a forages revered the Ganges not just as a river but as a Goddess. The self-purification of the people will help in maintaining the long-standing self-purification property of the river Ganges intact.

Introduction

The river Ganges is held as sacred and the symbol of India's age-old civilization and culture. It is a major river of the Indian subcontinent and is the lifeline of the people of India. The Ganges is unique because it is considered holy by the Hindu people of India. No river in the world plays a more important economic, social and cultural role in the lives of people than the Ganges. The river is also known as Maa Ganga or Mother Ganges and millions of people take a holy dip in the river each day. Millions of people rely on the river for their physical and spiritual sustenance. Also they believe that the water heals you from sin, and if you get cremated in the Ganges you are sure to get a better after-life.

The Ganges has an exalted position in the Hindus ethos. It is repeatedly invoked in the Vedas, the Puranas and the two Indian epics, the Ramayana and the Mahabhartha. It is believed that Bhagiratha, who after server austerities, propitiated the Ganga Devi, a Goddess and she agreed to come down to earth. Seeing the severity of impact of her fall that could be borne by none less than Shiva himself, Bhagirtha went into meditation again and obtained Shiva's consent after many more austerities. Finally, the river came down and fell into Shiva's matted hair, and hence to earth. This is the presumed site of the present-day temple at Gangotri.

Bhagiratha led the way on horse back and the river followed and an ocean formed from the waters there.This is the Sagar Island of today, where the Ganges flows into the Bay of Bengal (" Sagara" is also Sanskrit for ocean). Hindus use the water of the Ganga to cleanse any place or object for ritual purposes. Bathing in the Ganges is still the lifelong ambition of many of India's believing masses, and they congregate on its banks for the tremendously overcrowded Sangam, Sagar Mela or Kumbh Mela which are held on auspicious dates every few years.

The river emerges in spectacular fashion from an ice cave under the Gangotri glacier, a vast expanse of ice five miles by fifteen, at the foothills of the Himalayas (14000 ft) in North Uttaranchal. It is the source of Bhagirathi, which joins Alaknanda (originating nearby) to form Ganges at the craggy canyon-carved town of Devprayag. From Devprayag it goes to Rishikesh, Haridwar and then passing some of the most populous cities of India, including Kanpur, Allahabad, Varanasi, Patna and Calcutta and then to the Bay of Bengal flowing a distance of about 2507 Km. The largest tributary to the Ganges is the Ghaghara, which meets it before Patna, in Bihar, bearing much of the Himalayan glacier melt from Northern Nepal. The Gandak, which comes from near Kathmandu, is another big Himalayan tributary. Other important rivers that merge with the Ganges are the Son, which originates in the hills of Madhya Pradesh, the Gomti which flows past Lucknow, Yamuna, Chambal and Karvi.These tributaries are very useful in maintaining the volume of water in the river Ganga throughout the year.

There are two major dams on the Ganges.,one at Haridwar diverts much of the Himalayan snowmelt into the Upper Ganges Canal, built by the British in 1854 to irrigate the surrounding land. This causes severe deterioration to the waterflow in the Ganges, and is a major cause for the decay of Ganges as an inland waterway. The other dam is a serious hydroelectric affair at Farakka, close to the point where the main flow of the river enters Bangladesh, and the tributary Hooghly (also known as Bhagirathi) Continues in West Bengal past Calcutta. This barrage feeds the branch of the river by a 26-mile long feeder canal.On its way, the river is also fed by a dwindling supply of

subsoil streams. These streams are drying up because much of the forest has been cut down.

Life-line

400 million people live in the Ganges river basin and depend on the river for their lives. The water is used extensively for irrigation, agriculture production, Industries and domestic purpose.It also helps in maintaining water table of underground water by recharging. Floods of the Ganges have enriched the soil. This makes the Ganges Valley a great agricultural region in India. Fishing also is an important use of the Ganges. The electricity is generated at the waterfalls of upper part of the Ganges.The river is also important for transportation, many cities get their drinking water from the Ganga. There are many major industries along the Ganges. The important ones are food processing. clothes and other textiles, leather, paper and pulp, manufacturing of tools and Chemical processing. In the lower part of the river there is metal and other mineral production.

Pollution

It is quite unfortunate that Ganges the lifeline is becoming polluted. The pollution has become a huge problem on the Ganges. The river is polluted by enormous quantities of human and industrial waste. The Disease-causing organisms and poisonous chemicals abound in her ever-sacred waters.

Many of the cities have steps called Ghats along the riverbank so the people can bathe in the water. They also wash their clothes in the river. At many places there are times where massive bathing (millions of people) takes place and millions of people take bathe, during a few days. People are cremated and dumped in the river because they believe that the river will purify them (sometimes cremated people are not burned well because they can't afford much kindle). It is common Hindu practice to scatter the ashes of the dead in the Ganges. The people along it dump sewage into the river. Factories dump chemicals and waste into the river. Narora nuclear power plant discharges its water into the lower Ganges canal. Agricultural chemicals wash into it. There's too much grazing of animals that make waste, which runs into the river.

The pollution begins soon after the Ganges begins its slow journey through North India planes, some165 miles downstream at Rishikesh,most of its dry-season flow is diverted to Canals, first at Haridwar and then near Aligarh. At the same time, town and industries discharge a large amount of waste in the sacred waters. The major polluting industries on the Ganges are the leather industries, especially near Kanpur,which use large amounts of Chromium and other chemicals

and much of it finds its way into the meager flow of the Ganges. By the time the river leaves Kanpur, one of the big industrial centers along the river, the load of human, animals and industrial waste becomes overwhelming, threatening the rare species of fish, dolphins and soft-shell turtles. Allahabad is the sacred meeting point for the Ganges and the Yamuna, a river that becomes heavily contaminated asit oozes past the country's capital,Delhi.In ancient city of Varanasi, it is considered particularly auspicious to die here,where hundreds of corpses are burnt on the banks every day. Many bodies are pushed into the water without being burnt.However, industry is not the only source of pollution but a large volume of waste-estimated at nearly 1 billion liters of mostly untreated raw domestic sewage is dumped into the river per day. Also, inadequate cremation procedures contributes to a large number of partially burnt or unburnt corpses floating down the Ganges, not to mention livestock corpses. Thus pollution multiplies as the river moves downstream because very little fresh water is generated between towns. The global warming is also causing a decline in the snowfall on glacier, needed to replenish it.

The pollution of water can be a host of diseases-hepatitis amoebic dysentery, typhoid, cholera and cancer-among the roughly 400 million people who live in the vast Gangetic basin.Waterborne diseases such as diarrhoea and cholera sap the lifeblood from the people causing death malnutrition, especially for children. Hindus believe that a dip in the holy Ganges will cleanse their souls of sin. But the pollution that bedevils the river could do untold damage to the bodies of the faithful who bathe in it. The people cannot escape the physical on slaught of raw sewage, rotting carcasses, industrial effluent, fertilizers and pesticides that infect the river from the Himalayan foothills to the Bay of Bengal.

Ganga Action Plan

Alarmed by the rising level of pollution, an ambitious Ganga Action Plan was launched with great fanfare in 1986 by the Govt. of India to clean the river. But little has been achieved. Many sewage treatment plants were set up in major cities like Haridwar, Kanpur, Allahabad, Varanasi and Calcutta. Unfortunately treatment plants are not doing their job for which they were designed. The sewage is not being treated to their capacity. The plants are very energy intensive and expensive to run. The main plants remain off during the frequent energy blackouts, do not remove pathogenic bacteria and cause a build up of pollution alongside several villages. The plants need constant power supplies that are not available.It has met only 39percent of its primary target for sewage treatment. This results in sewage to back up throughout the city flowing out into the religious bathing areas, out through manhole covers and into the streets. The health problems are devastating.

Besides, less than half of the grossly polluting industrial units lining the 1,560-mile river had installed effluent treatment plants, and over 18 percent of them did not function properly. " The authorities claim that almost all industrial units are diverting their effluent to treatment plants but the ground reality is that their claim is exaggerated. The experts say the level of pollution in the river has been contained, even if it has not been eliminated. Electric crematoria were built but not in use due to religious sentiments. Meanwhile, the government is planning to build more than 50 dams and barrages to regulate the river-flow, supply water and generate power. The largest of them near Tehri has already attracted controversy amid concerns about safety and the environment.

Fighting Pollution with Religion

Religion is the most powerful tool of the Indian civilization.Not from today but from time immemorial religion has remained one of the most important aspects of the people of this land. Only an individual, that is ,one not divided against one self, can imbibe this humanizing state and claim to be religious. Without the stars in the sky and the sun rising behind the hill, without that woman with a child in her lap, and the man in an ancient turban passing by, without the glint of cheer in children's eyes, there can be no religion worth the name. Religion is the symbiotic relationship between man and his environment, promising a homogenized congenial ambience. The religious sentiments of the people have been responsible for each and every revolution that has ever taken place in this land of Gods. Today also there is need of a revolution not in the outer world but in the hearts and minds of the people who have for long worshipped the Ganges not only as their lifeline but as a Goddess who looks after her children just like a benevolent mother. Today this sentiment has to be aroused in each and every Hindu that they have now troubled their Mother a bit too much and that she is in a lot of pain.

Religion may succeed where the government has not. It is imperative to revive the religion feelings among the society so that besides that Government efforts to enforce using the scientific application for prevention and control of Ganges pollution, the guidelines given by ancient Rishis/ Sages for prevention and control of pollution are self-generated among the people. A large number of norms have been suggested in the Hindu's sacred literature. It has been suggested that there should not be any bank-side construction on river Ganges.A few examples of the instructions given in sacred literature are quoted here.

न दन्तधावन कुयादि गंगा गर्मे विचक्षण :
परिधेयाम्बराम्बूनि गंगा प्रेतसिनत्यजेत्।

पदमपुपाण'

i.e. Neither should one brush his teeth nor should one wash his clothes in the holy river Ganges.

मलं प्रक्षालयेत्तीरे ततः स्नान समाचरेत ।

'मेधानिति'

I.e. One should take bath in the river only after defecating elsewhere.

Thus, taking the example from such religious scriptures, the religious teachers should awaken the people about maintaining the sanctity of the river Ganges.Further, the religious heads of different organizations should come forward in cleaning and management of Ganga as they can catch the sentiments of people. People have great faith in them and follow whatever they preach. One of the most gallant examples of such a revolution spearheaded by religion was the effort made by the people of Shanti Kunj, Haridwar way back in 2000 when they lead their volunteers to clean the Ganges strip of Haridwar without any Govt.aid.Their efforts of 2000 were really commendable. Today there is a need of not only initializing such programs but also to see to it that these programs continue till each and every patch of this sacred river is cleared from dirt and also each and every national starts feeling it as his or her responsibility to keep their Goddess pure. The religious organization can facilitate in running environmental education and training centers/ programs and can promote active participation of pilgrims, riverside local villages, schools, community-based organizations in the cleaning and protection of the river. The religious sentiments of purifying the self should be aroused. The self-purification of the people will help not only in cleaning the Ganges water but also in maintaining the long-standing self-purification of the river Ganges intact.

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Effect of Parathion, an Organophosphorous Compound on estrous cycle of female *Rattus ratus*

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Abstract

20 adult female rats *Rattus ratus* were exposed with 5 ppm of parathion (organophosphorus compound) for 60 days and their vaginal smears were examined to observe the estrous cycle.It is very axiomatic from the results that estrous cycle has been disrupted in experimental animal treated with parathion, which has been observed by direct fall in number of estrous cycles in treated animal as compared to control.

Introduction

During reproductive life span of female mammals the ovary exhibits cyclic changes under the influence of pituitary gonadotropins and expels ova periodically. The exposure of various organophosphorous pesticide or insecticides determines the deterimental effect on reproductive function (Ronald 1997, Wevstorand Wringnaate 1968). These are highly toxic agricultural chemicals with wide variation in toxicity between different species (Janardhan *et al.* 1986). In women if primordial follicle are destroyed extensively they cannot be regenerated. This can cause premature ovarian failure, early menopause (Hirhifield 1991, Hoyer and Sipes 1996). During the estrous cycle the vaginal epithelium shows marked changes resulting in corresponding changes in the luminal cell population. These change provide a reliable index of ovarian activity to determine the reproductive stage of the animal vaginal smear taken at different stages for the cycle, shows characteristic cell population. An attempt has been made to analyze the reproductive toxicity of parathion on female *Rattus ratus*.

Material and Methods

The animal taken- Three months old female *Rattus ratus* mice, weighing between 28-35g showing regular 4-5 days estrous cycle were selected randomly from breeding stock. The mice were housed two per cage of ten groups in 30x30x15 cm stainless steel wires with proper aeration and

Parathion Administration: Technical grade commercial Parathion " KILDOT-D" of Kilpest India Ltd. Bhopal was dissolved in sterile distilled water at the concentration of 5 ppm and supplied assole source of drinking water .Two groups of mice were siupplied with sterile drinking water and observed as control.

. The mice were maintained at environment temperature and 12h : 12h L/D light periods and supplied the pellet diet " Gold Mohar" (Hindustan Lever Ltd. Mumbai) throughout the study.

Vaginal smear preparation: Beginning from first day of administration of water. The phases of estrous cycle was determined by observing the vaginal smear in the morning (0800 h to 1000h) as described by Cooper *et al.* The Vaginal smear was Stained with giemsa solution (20-30 min) and observed by light microscope. Care was taken to avoid mechanical stimulation of the cervix during this procedure, to prevent pseudopregnancy. Only one attempt was made to obtain each smear.

Results

The controlled mice exhibited regular estrous cycle and normal duration of each phases of estrous cycle while treated female has shown a drastic and significant decrease in the number of estrous cycle. It is very apparent that there are irregular and disrupted changes occurs in administered animals. As per the results in given table it is very axiomatic that control animal shows 13 ± 0.22 to 14 ± 0.25 estrous cycles while in treated animal it has found to be 08 ± 0.00 to 11 ± 0.23 cycle with standard deviation of 10 ± 2.21 cycles during treatment of 60 days.

Table: Effect on estrous cycle in *Rattus rattus* mice after oral exposure to parathion

Group	Treatment Dose of Parathion	Number of Mice	Number of Cycles
Control-1	Nil	2	14 ± 0.25
Control-2	Nil	2	13 ± 0.22
Group-1	5ppm	2	11 ± 0.25
Group-2	5ppm	2	08 ± 0.00
Group-3	5ppm	2	13 ± 2.00
Group-4	5ppm	2	09 ± 0.16
Group-5	5ppm	2	10 ± 2.21
Group-6	5ppm	2	09 ± 0.28
Group-7	5ppm	2	11 ± 0.23
Group-8	5ppm	2	09 ± 0.19

Disscussion

A significant change has been observed in estrous cycle of parathion administered female *Rattus ratus*. Cyclic changes of the vaginal smear observed in the estrous cycle gives a reasonable index of the ovarian activity and its hormonal synthesis of estrogen and progesterone (Prakash *et al.*). The levels of these hormones are controlled by hypothalamus relesaing gonadial hormones and pituitary gonadotropins (Lener 1969).As per the results obtained from the controlled mice the duration of estrous cycle in normal female rat is 4-5 days while in treated animals a irregular, incomplete and interrupted estrous duration has been observed; it may be due to the hormonal imbalance, immature follicle formation and inhibition of cellular activites in ovary. Recently similar results have been reported that the rats treated with a carbamate fungicide mancozed causes a significant decrease in the number of estrous cycle and the duration of proestrous, estrous and metestrous with a concominal at significant increase in diestrous phase (Gupta and Kadal 1989). Similar results have been reported with other organochlorine pesticide like DDT, chlordecone, methoxychlore and dicofol showed a capacity to induce the persistant vaginal estrous, thereby affecting the number of estrous cycle resulting from the hormonal imbalance and prolonged estrous (Welch *et al.* 1969 ,Jadaroamkunti and Kaliwal 1999). The reason behind the drastic decrease in estrous cycles is the reduced synthesis of steroids in the ovary, causing imbalance in the estrogen: progesterone ratio. Further investigation on the mechanism of parathion ovarian toxicity will be necessary.

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Phytotoxic Effects of *Eucalyptus globulus* leaf extract on seed germination and seedling growth of Vicia

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Abstract

Eucalyptus globulus L.(Myrtaceae) stared as antisocial tree for social forestry (Kohli, 1987) is commonly transplanted through out India on roadsides, bare lands and boundaries of crop fields without considering its allelopathic effects on crop plants, especially cereals and pulses. The aerial parts, especially leaves of this tree contain volatile tarpenes (Del Moral and Muller, 1970), water soluble toxins and growth inhibitors. (Grummer and Beyer, 1960 and Al-Mousawi, Al-Naib,1976 and Pandhy *et al*. 1992). Toxic effects of different concentrations of leaf extract of *Eucalyptus globulus* (Viz-5,10, 15, 20 & 25 percent) was studied on percentage of seed germination,their survival, growth of radical and plumule and establishment of secondary roots on three species of Vicia-*V. narborensis, Vicia benghalensis.* and *V. faba.*In the present investigation each concentration showed inhibitory effects of the above parameters which gradually increases with increasing concentrations of the leaf extract. Delayed germination was also noticed in the treated seeds. *Vicia narborensis* proved to be more sensitive to these toxic leachates than the other two species. The above findings clearly showed that the transplantation of *Eucalyptus species* on boundaries of crop plants should be totally banned. Further investigation on its Cytotoxic effect (if any) is in progress.

Introduction

In plant communities, many plant species interact with each other, thus, regulate the growth of neighbouring plants by releasing certain chemicals, stimulators or inhibitors resulting into an allelopathic action (Putnam and Tang, 1986), Such Chemic Substances which interfere the physiological processes and life-cycle of another plant species in communities are referred as allelopathic substances and the phenomenon as Allelopathy. These allelochemic substances are present in various plant parts and are released into the environment by various processes such as leaching, volatilization, root exudation and decomposition of plant residues (Rice, 1984). Recently several works have been carried out on the allelopathic effects between crops and crops,between weeds and crops and between weeds and herbaceous plants (Eyini *et al.* 1989, Chandel and Mehta, 1990, Singh, 1999, Pandhy *et al*. 2000), but interactions on the tree crops are still scanty.

Eucalyptus released several volatile tarpenes (Del Moral and Muller, 1970), water soluble toxins and growth inhibitors (Grummer and Beyer, 1960, Al-Mousawi and Al-Naib, 1976, Pandhy, 2000) and volatile materials (Baker, 1966) which in one or other way inhibit the growth of crop plants.

Considering the allelopathic effect of *Eucalyptus globulus* on several important crop plants and termed as antisocial tree for forestry (Kohli, 1987), it was planned to see the phytotoxic effects of *Eucalyptus globulus* on seed germination, seedling growth and its survival on three species of Vicia Viz-*V. faba, V. narborensis* and *V. benghalensis*.

Materials and Methods

Fresh and matured leaves of *Eucalyptus globulus* (Myrtaceae) were plucked, washed thoroughly, shade dried and then soaked in distilled water for 48 hrs, (100 gms in 1 liter of distilled water). The leachate so obtained was considered as Stock solution. Further dilution was made by adding adequate amount of distilled water into the stock solution to obtain 5, 10, 15, 20 and 25 percent concentrations of the Leachate.

Seeds of *Vicia faba* and *V. benghalensis* were procured from local registered suppliers while seeds of *V. narborensis* was obtained with the courtesy of Dr. A.K. Singh**,** the then Professor of Botany, M. S. College, Motihari.

100 healthy seeds of each species of *Vicia* were taken, thoroughly washed in distilled water, then kept for soaking in different test tubes containing various concentrations of the leachate. After soaking for 24 hr. seeds were taken out, washed with distilled water and then allowed to germinate in different pertridishes lined with moist filter paper. A control set in distilled water in identical condition was also maintained for comparison. The daily record of seed germination and their mortality was noted upto a week, while length of radical, plumule and number of secondary roots were noted after seven days.

Results and Discussion

As it reveals from Table 1,2 and 3 that the percentage of seed germination and its survival is dose dependent. Increase of leachate concentration decreases the percentage of seed germination and survival of seedlings. It was also observed that increase of concentration delayed the process of germination and inhibited the growth of seedlings in all the test

cultivars of Legumes. *V. narborensis* proved to be more sensitive than other two species of Vicia.

Delayed germination with increasing doses of the leachate might be due to presence of more phytotoxins which arrest the protease enzyme activity or action of hydrolytic enzymes (Shrivastava *et al.* 1972, Singh and Saxena, 1991), Saxena and Singh (1987) are of opinion that seed germination is mostly controlled by osmotic potential which regulates the action of hydrolytic enzymes. Mishra & Srivastava (1987) and Khosh-Khui and Bassiri (1979) reports that the toxic substances present in the leachate damaged the enzyme system involved in the metabolic and repair mechanism or their degradation products in excess. Similar opinions have also been made by Nicollier *et al.* (1985), Singh & Singh (1997), Jha *et al*. (1998), Singh (1999) and Singh & Singh (2001)while Choe (1972) reports that indigenous hormones are denatured or leached out to the surround medium by exogenous application of plant regulating chemicals. In contrast there are several reports that the secondary metabolites such as α & β pinene, Limonine, Linolol, P-cimene, Citronella, α– terpenol, geraniol, citral etc. present in leaves of *Eucalyptus* are of toxic nature, hence might have inhibited the process of germination resulting decline in percentage as well as delayed in the germination process. Similar reports have also been made by Srinivasan *et al*.(1990) on Piegeonpea & Soyabean, Pandhy *et al*. (2000) on finger millet and Devasagayam and Ebenezar (1996) on arable crops.

Reduction in seedling growth as observed in present investigation has also been noticed by several co-workers such as by Singh and Nandlal (1993) on wheat, mustard and chick pea treated with *Eucalyptus rostrata* by Jaikumar *et al.* (1990) on ground nut; Pandhy *et al* (2000) on Ragi treated with *E.globulus* and by Singh and Singh (2001) on *Vicia faba* treated with *Cannabis* extract and by Singh (1999) on *Ageratum conyzoides* treated with *Parthenium hysterophorus,* Tripathi *et al.* (1981) and Mukherjee and Sahai (1985) have reported that the allelopathic actions differ from plant to plant. Gleissman and Muller (1978) is of opinion that allelochemics of plant might be incorporated into the soil by leaching of the substance from shoot canopy due to dissolving action of rain water and they might have arrested the physiological, biochemical and cytological activities of seedlings leading to poor seedling growth, similar opinion has also been made by Pandhy *et al.* (2000). While Kohli (1990) is of opinion that reduction in seedling growth by the allelochemics might be due to inhibition and/or checking of protein,nucleic acid and carbohydrate synthesis. The

opinion of Kohli (1990) seems to be more authentic as these allelochemics have greater amount of terpenoids, flavonoids and phenolics, which are more toxic to the various physiological and metabolic processes related to the seedling growth and has directly or indirectly inhibited the seedling growth and number of secondary roots. Decrease in the length of radicals and plumules at higher doses may safely be attributed to the toxic effects of the allelochemicals or their degradation products on the root tipcells, that retarded cell divison, thus,decline the length of primary and secondary roots and number of secondary roots. Similar findings have also been made by Shastree *et al.* (1989), Bansal (1992), Singh and Singh (1997), and Singh (1999).

Table-1 Effect of leaf leachate of *Eucalyptus globulus* on seed germination and seedling growth of *Vicia faba*

Leaf leachate Conc.(%)	Germination (%)	Periods taken into germination (in hrs.)	Survival (%) (mm)	Length of plumule and Radical (after a week)		No.of Sec. roots (after a Week)
				Radical (mm)	Plumule (mm)	
Control	100	48-60	95.00	55	81.5	18
5	98	48-60	91.84	51	78.4	16
10	90.00	48-72	90.00	40.5	72.6	13
15	90.00	60-84	87.7	46.2	66.4	08
20	86.00	60-84	84.88	42.4	60.5	06
25	82.00	72-84	80.48	38.5	54.2	06

Table-2 Effect of leaf leachate of *Eucalyptus globulus* on seed germination and seedling growth of *V. narborensis*.

Leaf leachate Conc.(%)	Germination (%)	Periods taken into germination (in hrs.)	Survival (%)	Length of plumule and Radical (after a week)		No.of Sec. roots (after a Week)
				Radical (mm)	Plumule mm)	
Control	94	48-60	94.68	51.4	73.2	20
5	90	48-72	90.00	50.8	72.8	18
10	86	72-84	84.88	46.00	72.4	12.
15	80	72-84	80.00	39.02	65.4	08
20	70	84.96	75.71	37.3	58.1	04
25	65	84-108	72.30	35.2	44.4	02

Table-3 Effect of leaf leachate of *E.globulus* on seed germination and seedling growth of *V. benghalensis.*

Leaf leachate Conc.(%)	Germination (%)	Periods taken into germination (in hrs.)	Survival (%)	Length of plumule and Radical (affer a week)		No.of Sec. roots (after a week)
				Radical (mm)	Plumule (mm)	
Control	96	48-60	100	62.24	120	32
5	90	48-60	90.00	60.05	115	27
10	90	48-72	87.77	54.22	105	27
15	85	48-84	81.17	49.20	94	20
20	75	60-84	80.00	45.45	91	12
25	70	60-96	78.57	40.20	82	09

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Mosquito larvivorous potential of some indigenous fishes

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Abstract

Natural enemies such as predators play an important role in checking the proferation of vectors in Natural habitat in breeding grounds. *Gambusia affinis* popularly known as Doctor fish is well known predatory fish can be cultured and used in vector control programme. In the present study, use of 3 indigenous fishes in vector control have been reported. The fishes were recovered from Machna river and used in the laboratory to control *Anophelese stephensi* and *Aedes aegypti* larvae. Laboratory testing in glass aquarium contaning 5 fishes of each *Ajystus cavasius, Danio devario, Rasbora daniconius* alongwith *Gambusia affinis*, revealed that as far as predatory efficacy is concerned *Mystus cavasius* stands 1st and consumed 130 larvae/day/fish. It was noticed during the course of experiment that fishes prefer I/II instar larvae than III/ IVth instar larvae of both the species. The study was also conducted with and without fish food. To observe larvivorous potential. It was noticed that fish food has some effect on the predatory habit of these fishes. In the presence of fish food, the predatory period was found to be increased by 5 minutes to 20 minutes more. Gut content analysis of the fishes showed not only the mosquito larvae but some nematodes, annelids. beetles, algae and unidentified material. The result of the present study thus suggest that indigenous fishes edible value can be cultured in small ponds and other water bodies to reduce the vector bone diseases. Without disturbing the ecosystem and causing no ill effect to the human health.

KEYWORDS:Larvivorous, Indigenous, Anopheles, Eco-friendly,Gambusia,Mystus ,Rasbora.

Introduction

Haas (1984) provided a guide for the preliminary identification of larvivorous fishes. Das and Prasad (1991) reported that rice cultivation in the country contributes to the production of many mosquito vectors. It provides breeding places for *Anopheles, Culex, Aedes* and *Monsonia*. The control of the mosquitoes in rice-field can be achieved through the introduction of *Gambusia affinis* with two indigenous fish *Danio oryzias*. Yadav and Das (1990) also have described the role of these two fishes in the control of mosquito breeding in the rice-field. Gerverich and Laird (1985) have mentioned that as many as 253 species of larvivorous fishes are used in the biological control of mosquitoes in different parts of the world. Nelson and Keenan (1992) mentioned that

indigenous fish species *Fundulus zebrius* are among the most important agents use for mosquito control. Similar views have also been expressed by Sholdt *et al.* (1972).But WHO Expert Committee (1982) recommends that Doctor fish should be used less than the local fishes. Haas and Pal (1984) suggest the need for more careful evaluation of larvivorous fish species besides *Gambusia affinis*. Recently, Saxena. (1996) also emphasized the need of local fishes for mosquito control in aquatic habitat.

Bioenvironmental control of malaria was launnched in Vizadandi Block in Mandla district of Madhya Pradesh by Singh *et al.* in (1989).,since then there is no much progress made in the direction of bioenvironmental control of mosquito in this state. During 1970 widespread resurgence of malaria was reported in India. (Sharma 1989) and recently also there have been an outbreak of malaria in the Eastern pocket of India. The cerebral malaria caused by the *Plasmodium falciparum* is on the rise now-a-days. Therefore, biological control looking to the local ecological and environmental conditions, needs a special attention, Haq *et al.* (1991) described the role of *Gumbusia affinis* along with food fishes for the control of mosquito vector. Panicker *et al.* (1992) made a study on the cost-benefit analysis report . Panicker 1986 mentioned that mosquito control strategies are closely associated with social economy, so in any future program, economic factor should be dealt with care.

A number of tropical diseases are transmitted by different species of mosquito vectors which breed a variety of aquatic habitats. As pointed out by Prasad *et al.* (1993) rice fields play a very important role in building up a high adult vector density because of vast.

Materials and Methods

For the present study, the three indigenous fishes were used.The equipments were collected in glass aquarium in laboratory condition. During the course of present study, three indigenous fishes were collected from fresh water bodies in and around Vidisha.The fishes tested for the present study for predatory efficiency test were *Danio devario, Mystus cavasius, Rasbora daniconius* along with *Gambusia affinis* which served as standard predatory fish. The fish larvivorous potential was examined individually or each fish as well as all the three fishes taken together in a group. The experiments were done alongwith fish food and without food.

Results

From the result in table no.-1, predatory performance test was performed in glass aquarium (22x22x38cm.)having five fishes of each species to which 50 IV instar larvae of *Anopheles stephensi* were added in which two litre of water was already poured. The predatory period which was recorded show that *Mystus cavasius* took 2 minute period to consume 50 larvae. This was followed by *Rasbora daniconius* which took 5 minutes to consume entire 50 larvae. The *Danio devario* fishes, however, took 30 minutes to consume 50 larvae.

Therefore, from the results in Table-1, predatory rate was found to be quite high in case of *Mystus cavasius*. These preliminary observations were further confirmed by taking each species of fishes individually in glass beaker. The results mentioned in Table-1 indicate the predatory efficacy of these fishes without fish food.

Results mentioned in Table-2 show the predatory efficacy of the fishes provided with 10 mg. of fish food per container per day along with the IV instar larve of *Anopheles Stephensi*. It was noticed that predatory period got increased, it was found to be 5 minutes, which was just double to the period of consumption of larvae in the absence of fish food in case of *Mystus cavasius,* the highly voracious fish. However, in case of *Danio devario* presence of fish food does not affect the predatory habit and as indicated in the Tables-1 & 2 the fishes took 30 minutes to consume 50 IV instar larvae.

From the results, it appears that fish food has some effect on the predatory habit of these fishes as *Rasbora daniconius* also in the presence of fish food, the period of predation of 50 larvae was found to be increased as compared to the fishes tested without fish-food. Even the larvivorous fish *Gambusia affinis* also took five minutes more to consume 50 larvae in the container having fish food. Therefore, it seems that fish-food in the natural habitat may influence the predatory behaviour of these fishes.

Table-3 shows the predatory efficacy of the fishes in group. When four different species of fishes were taken together in a glass aquarium with and without fish food. 75.1% Consumption without fish food while there was only 60.8% consumption of prey in the aquarium provided with fish food along with the prey.

The result showed that predation rate per fish per minute got considerably decreased in the container provided with the fish food. 0.760/min./ fish as compared to 1.121/min./fish in glass

aquarium without fish food. Thus, it is quite apparent from the results that the standard fish food reduce the rate of predation of fish.

This, therefore, should be taken into consideration while working on larvivorous potential of the fishes as biological control agents against mosquito vectors. Since, in the aquatic ecosystem, the natural habitat of fishes harbours variety of other organism along with mosquito larvae.

Laboratory test were conducted in glass aquarium containing five fishes each, (except) *Mystus cavasius* (3). 400 IV instar Anopheline larvae were introduced in the aquarium on the first day, those that survived 24 hours later were counted and the number made up to 400 again. The experiment lasted for four days.

Tests on larvivoracity revealed (Table-4) that *Poecilia reticulata* and *Gambusia affinis* fed on an average 40.5 larvae per day while maximum 132 larvae per day were consumed by *Mystus cavasius.* The other two fishes *Danio devario* and *Rasbora daniconius* consumed only 80 larvae per day. Therefore, among 5 fishes. *Mystus cavasius* consumed the highest number of IV instar larvae of Anopheline mosquitoes.

Results in Table-5 shows the ranking of the fishes with larvivorous behaviour of each. The initial ranking was done on the actual number of larvae consumed. However, the rate of consumption, when compared in relation to the body weight of fishes was very high for *Mystus cavasius* (18.95 gm.body wt./day), followed by *Poecilia reticulata* (15.5 gm body wt./day).

The Table also shows that maximum initial ranking was noticed in *Mystus cavasius* for culicine and Anopheline larvae equally (130 larvae/day/fish).There is a slight difference in the initial ranking of anopheline and culicine larvae of the five different fishes. Except *Mystus cavasius*, the other fishes showed slightly higher consumption of culicine rather than anophelene larvae.

Table-6 showed the predatory habit of fishes on culex and anopheles larvae. The five different fishes were kept separately in glass beaker containing a single specimen of each I/II instar and III/ IV instar larvae of culex and anopheles in counted number were released in each beaker and the predatory habit was examined after 24 hour interval .The results mentioned in the table are the data for 24 hour duration. The results showed that there is no preference regarding the two different larval species of mosquitoes. Only in *Danio, Rasbora* and *Gambusia,* it was noticed that they show some preference to the I/II instar larvae of both the species and a little less to the III/IV instar larvae.

Discussion

It is quite apparent that the maximum rate of consumption of larvae was noticed in *Mystus cavasius, Rasbora daniconious* ranks second as far as its predatory habits are concerned. The rate of feeding in *Gambusia affinis* was ranked third. From the results it was noticed that *Mystus cavasius* consume all the larvae within 5 minutes when the fish-food also dispersed in the aquarium (10 mg/aquarium). No doubt, all the fishes consume the larvae left in the aquarium but their predatory rating was quite different. *Mystus* seems to be a potent larvivorous fish which preferred the larvae diet even if there is a preferential choice of fish food.

The predatory behaviour of all the fishes were also examined by taking all the five different fishes in a group. From the results, it is quite clear that predatory potenial was suppressed when fishes were provided with larvae and fish food (60.8%) as compared to the 75.1% larvivorous potential of the fishes when there was no choice except larvae.

The larvivorous potenital when analysed in terms of number of larvae consumed/ minute/fish. the *Mystus cavasius* and *Rasbora daniconius* passed the highest rate of predation in laboratory condition. Therefore, the results conclude that *Mystus* and *Rasbora* could be introduced in small ponds ditches, reservoirs and other such habitats where mosquito breed as biological control agents.

The mosquito control measures being shifted towards ecologically safe, less hazardous and economically feasible methods such as bioenvironmental and biological control measures. Larvivorous fishes,predatory insects as well as other bioagents are therefore being tried and the results of the present study seemed to be quite encouraging for using fishes *Mystus cavasius* and *Rasbora daniconius* as a potential biocontrol agent of mosquito larvae. Prasad & Sharma (1994) also stressed the needs of indigenous fishes in biological control of mosquitoes. Similarly, Jayshee & Panicker (1992) also reported the use of more than 34 indigenous fish species for larvivorous potential and found that *M.cupanus* possessed the highest rate of predation in laboratory-cum-field trial. Ismail (1988) also suggested the use of fishes as potential biocontrol agents for mosquito. The results of the laboratory experiments by taking indigenous fishes, therefore, seems quite encouraging that besides , Guppy fishes, *Mystus & Rasbora* like small sized fishes could be used as biocontrol agents of mosquitoes. A field trial will be followed later on.

As many as 253 or more species of larvivorous fishes have been reported as biocontrol agents of mosquito by Geberich and Laird (1985). From the present study also, it emerges that indigenous larvivorous fishes have more advantage than exotic ones as they are well-suited to the local conditions, similar views have also been expressed by Hass (1984). The maximum feeding intensity was observed for *Mystus cavasius* (132.0 larvae/day) which was found to be superior predatory intensity as reported by Jayshree & Panicker (1992) in the case of *A.testudinus* (88.89%). Sharma *et al*. (1987) also reported the role of indigenous fishes in the control of mosquito breeding. They have emphasized the production of edible fishes with indigenous larvivorous fishes to motivate the village community for the composite fish culture on large scale to control mosquito breeding and improve the village economy. Haq *et al*. (1991) have prompted the culture of *Gambusia affinis* with fishes. Victor *et al.* (1994) have also reported the use of fish as biological control agents to control the breeding of mosquitoes in the rice-fields of Southern India. Therefore from the discussion, it seems that composite fish culture can be a good source of economy as well as of biological control agents of vectors.

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Table-1 Predatory Efficiency of Fishes without Fish Food (Individual Fishes)

S.No.	Fish name	Number of Fishes	Predation onIV instar larvae	Predatory Period	Larvae Fed
1.	*Danio devario*	*5*	*50*	*30 minutes*	*50*
2.	*Mystus cavasius*	*5*	*50*	*2 minutes*	*50*
3.	*Rasbora daniconius*	*5*	*50*	*5 minutes*	*50*
4.	*Gambusia affinis*	*5*	*50*	*10 minutes*	*50*

* IV instar larve of *Anopheles stephensi* in three replicates

Table-2 **Predatory Efficiency of fish with fish food (Individual fish)**

S.No.	Fish Name	Number of Fishes	Fish Food	Predation on Larvae	Predatory Period	Larvae Fed
1.	*Danio devario*	5	10 mg.	50	30 Mintues	50
2.	*Mystus cavasius*	5	10 mg.	50	5 Minutes	50
3.	*Rasbora daniconius*	5	10 mg.	50	30 Minutes	50
4.	*Gambusia affinis*	5	10 mg.	50	15 Minutes	50

* *Anopheles stephensi* IV instar in three replicates.

Table- 3 Predatory efficiency of fishes in Group

S.No.		No. of Fishes	No.of prey	Predatory period	No. of prey consumed	% of feeding	Predatory rate/min./fish
1.	Without fish food	4	200	33.3 minutes	151.3	75.1%	1.2080
2.	With fish food	4	200	40.0 minutes	121.66	60.8%	0.7602

Table- 4 Laboratory test for larvivoracity

S.No.	Fishes	Size in cms.	Fishes No.	Number of Mosquito larvae consumed					
				Day-1	Day-2	Day-3	Day-4	Total	Average
1.	*Danio devario*	4.0-6.0	5	400	400	400	400	1600	80
2.	*Mystus cavacius*	4.0-7.0	3	396	386	400	400	1582	132
3.	*Rasbora daniconius*	3.0-4.0	5	400	400	400	400	1600	80
4.	*Gambusia affinis*	2.5-3.0	5	350	130	100	330	810	40.5
5.	*Poecilia reticulata*	2.5-3.0	5	350	100	130	330	810	40.5

Table - 5 Ranking of Larvivorous fishes based on predatory efficiency

S.No.	Fish species	Predatory on Culicine Larvae		Predation on Anaphelene larvae	
		Initial	Ranking based on per gm. body weight	Initial	Ranking based on per gm. body weight
1.	*Mystus cavasius*	130	18.45 gm	130	18.45 gm
2.	*Poecilia reticulata*	120	15.5 gm	120	15.5 gm
3.	*Rasbora daniconius*	115	10.2 gm	110	10.2 gm
4.	*Danio devario*	110	5 gm	110	5 gm
5.	*Gambusia* affinis	90	5 gm	80	5 gm

Table - 6 Predatory Habits of Fishes on Mosquito Larvae

S.NO.	Fish species	Pre density of IV instar larver of			
		Culex quinquefasciatus		*Anopheles stephensi*	
		I/II instar	III/IV instar	I/II instar	III/IV instar
1.	*Mystus cavasius*	130	90	130	90
2.	*Poecilia reticulata*	120	85	120	85
3.	*Rasbora daniconius*	115	85	110	75
4.	*Danio devario*	110	80	110	70
5.	*Gambusia affinis*	90	45	80	35

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Assessment of noise pollution in the city of Hardwar (Uttaranchal) India

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Abstract

A study has been made to assess the noise pollution at six places of Hardwar city. Study was carried out for the period of three to five hours on 25th May-2002 for the parameters average, minimum and maximum noise in different categorized area. The results revealed that minimum and maximum pollution of noise varied between 56.1 to 83.6 dB(A) Leq.in the city. The present paper will be key for the awareness of public and authorities to take an action for control of noise pollution creators.

KEYWORDS **: *dB(A)Leq. ,Silence zone, noise pollution***

Introduction

Hardwar is a well known city for the people who believe in Hindu religion. Hardwar city is situated along the Ganga river at the boundary between the Indo-Gangetic plain (south) and the Himalayas foot hills from a holy river Ganga passed after hills. The Hardwar is a religious and pious city famous for its natural beautiful scenario where lacs of pilgrims take a sacred dip in Ganga river on Amavasya and Purnima, Ardha Kumbh and Maha Kumbh mela held after every six and twelve years. During Kumbh Mela population of pilgrims reaches up to more than 10 lacs. Besides this everyday bathing activities are also held at Har -Ki- Pauri ghats of river bank of Ganga. Number of vehicular movements are found in this city per day and during evening period Aarti conducted at Har Ki Pauri Ghats which enhanced to noise pollution. Main causes of noise pollution in this city are vehicular movements blowing horns by vehicles, during worships in temple and at ghats playing music equipments. Keeping all these things in mind,a noise pollution study was conducted at six places of the city in different categorized area in the month of 25th May-2002.

A number of studies on noise pollution have been performed at various cities in India (Tondon and Pandey,1998; Edison *et al.* 1999; Ingle *et al.* 2001 and Singhal S.P., 2000). A study was undertaken to monitor level of noise around Netaji Subhash Chandra Bose International Airport, Kolkata by CPCB (2001).

Material and Methods

As materials no more items were required during sound monitoring , only sound pressure level meter was used to observe the data of noise level.Method of sampling was adopted as per CPCB guidelines and manual of the instrument. Sound pressure level was monitored during day time in "A" weightage using a sound pressure level meter make of Quest technology model no. 1900 (USA). It is highly sensitive instrument with computer aided programs. The data of noise level have been recorded in the form of minimum, maximum and average. Sound level monitoring was conducted at different places characterizing commercial, residential and silence zones.

Sampling Stations

To assess the representative noise monitoring, six sampling stations were selected in different categorized area of the city. Category wise area were chosen as below

S.No.	Category	Area Circle	Monitoring Stations
1.	Commercial Area	A	Ranipur More market
2.	Residential Area	B	Vivek Vihar Colony,Ranipur Mode
3.	Silence Zone	C	Court of Coty Magistrate
4.	Silence Zone	D	City hospital Emergency Ward
5.	Silence Zone	E	Before Aarti Pujan at Har-Ki- Pauri
6.	Silence Zone	F	During Aarti Pujan at Har-Ki-Pauri

Sampling for noise level observation was conducted for at least 10 minutes at each sampling stations and approximately 10-12 observations of sound level were recorded at each sampling point. The values of minimum,maximum and average were noted from the noise level data which are given in Table-1.

Table:1: Results of Sound pressure level data at different sampling stations in the city of Haridwar

S.No.	Sampling Stations	Date of Sampling	Period of monitoring-(Hours)	Area	Observation valuesdB(A)	Values in dB(A) Leq.		
						Average	Minimum	Maximum
A.	Ranipur mode market	25-5-2002	15:30-15:40	Commercial	74.9,73.9,75.8,77.0,74.4,72.-8,75.5,71.9,75.3,74.7,74.4	74.61	71.9	77.0
B.	Vivek vihar colony (Ranipur mode)	25-5-2002	16:00-16:10	Residential	62.2,61.9,62.9,63.8,63.4,59.-0,61.0,67.5,64.5,62.9,69.8	63.55	59.0	69.8
C.	Court of City Magistrate	25-5-2002	16:35-16:45	Silence	57.7,56.1,56.5,57.0,63.0,60.-1,62.0,57.2,59.1,61.9,62.2,5-8.1	59.24	56.1	63.0
D.	Emergency ward cityhospital	25-5-2002	17:20-17:30	Silence	66.0,67.1,68.9,67.5,64.9,66.-4,65.9,65.1,71.4,66.9,67.3,7-0.3	67.31	64.9	71.4
E.	BeforeAartiPujan at Har-Ki-Pauri ghats	25-5-2002	18:10-18:20	Silence	73.0,70.3,63.9,62.2,66.5,63.-9,64.2,66.0,67.0,72.9,73.9	67.62	62.2	73.9
F.	During Aarti Pujan at Har-Ki-Pauri ghats	25-5-2002	19:30-19:40	Silence	75.0,78.5,72.0,77.0,81.5,82.-5,79.6,83.6,79.8,75.0	78.8	72.0	83.6

TABLE-2 Ambient Air Quality Standards in respect of Noise.

Sl. No.	Category of area	Limits in dB(A) Leq.	
		Day Time	Night Time
1	Industrial area	75.0	70.0
2	Commercial area	65.0	55.0
3	Residential area	55.0	45.0
4	Silence Zone	50.0	40.0

Note:
1- Day time is reckoned in between 6.00 a.m.-10.00p.m.
2- Night time is reckoned in between 10.00p.m.-6.00 a.m.
3- Silence is defined as areas upto 100 meters around such premises as hospitals, educational institutions, courts and eminent temples.
4- Use of vehicular horns,loud speakers and bursting of crackers shall be banned in those zones (Notification 2000).

Results and Discussion

Results of sound pressure level data are given in Table-1 and standards of ambient air quality in respect of noise are mentioned in Table-2.

As it is evident from the table-1 that the values of sound pressure level varied between 71.9 dB (A) to 77.8 dB (A) and average sound value was obtained 74.61 dB (A) Leq. At sampling point- A. Since this comes within the commercial area where number of vehicular movements and other activities are held. Average value of noise at this place is beyond the standard prescribed for this area. It may be due to chauraha of Ranipur mode from where heavy traffic passes.

Sound pressure level values ranged from 59.0 dB (A) to 69.8 dB (A) Leq at sampling-B and at this point average value of noise level data were recorded 63.55 dB(A) which is more than the limits prescribed for the categorized area. This sampling point comes within residential area however averaged values of sound level is observed higher due to vehicular movements at Ranipur mode chauraha from where noise level remains generally higher.

The Values of sound pressure level varied between 56.1 dB (A) to 63.0 dB (A) Leq. and average value 59.24 dB (A)Leq. at monitoring station-C. This station is considered as silence area as per rules (2000). Average value at this point is higher than the limit prescribed for the silence zone. Which is due to movement of light vehicles and noise contamination of heavy traffic's horns blowing at main road of the city.

The minimum and maximum noise level at sampling point-D were observed as 46.9dB (A) Leq. and 71.4 dB(A) Leq. and average value was obtained 67.31 dB (A) Leq. Since this sampling point is

made within the city Hospitals emergency ward which is situated at main road of the city. Hospitals are defined within silence zone and at this point average value of noise level also found more than the limits prescribed for silence zone. Higher value may be due to instantaneously movements of vehicles and blowing of horns, operating of generator sets during power failure as hospital needs regular power.

The value of minimum maximum and average noise level were obtained as 62.2, 73.9 and 67.62 dB (A) leq. at sampling point-E i.e. Har Ki Pauri. This sampling point comes within silence area as it is also defined as silence zone due to eminent temples which are situated here. The average value of noise level is higher than the limits prescribed for the silence zone (Table-2). Noise level monitoring was conducted at this point before Arti Pujan. However average value was obtained higher due to movements of light vehicles and blowing of horns. Light vehicle bring the pilgrims from roadways bus station and railway station.

Values of noise level at sampling station-F (Har- Ki- Pauri Ghat) ranged between 72.0 dB (A) 83.6 dB(A) and average sound pressure level observed was 78.8 dB (A) Leq. Since noise level monitoring was conducted at this sampling point during Arti Pujan period (19.30 hrs to 19.40 hrs) the average value of noise level was obtained too much higher than the other sampling stations which are much more than limits prescribed for silence zone (Table-2). Higher average value of noise level at this point may be due to playing Tom-Tom and music equipments during Arti Pujan and blowing of horns by light vehicles and movement of heavy traffic on Hardwar- Rishikesh road which increases the noise level. Babu (2003) reported noise (30.0 to 90.0 dB (A)) Leq. by traffic.

Higher noise can disturb our work, rest, sleep and communication. It can damage our hearing and evoke other psychological, physiological and probably pathological reaction. However because of complexity, variability and the interaction of noise with other environmental factors, the adverse health effects of noise do not lend themselves to a straight forward analysis. Hearing loss can be either temporary or permanent. Noise induced temporary threshold shift (NITTS) is a temporary loss of heariny activity experience after a relatively short exposure to excessive noise. Pre-expossive hearings is covered fairly rapidly after cessation of the noise. Noise induced permanent threshold shift (NIPTS) is an irreversible loss of hearing that is caused by prolonged noise exposure. Both kinds of loss, together with presbyacusis, the permanent hearing impairment that is attributed to the natural aging process, can be experienced simultaneously ETI

(2000).

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Impact of IDPL effluent on water quality of river Ganga at Shyampur Khadir, Rishikesh (Uttaranchal)

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Abstract

Present paper deals with the impact of IDPL effluent on water quality of river Ganga at Shyampur Khadir, Rishikesh. A significant deterioration of water quality of Ganga was recorded at Shyampur Khadir. Water quality of river Ganga at Pashulok Barrage (1.5 Km. before discharge of IDPL effluent) was better in term of various physicochemical characteristics, valued mg/lt, chloride- 5.6, DO- 8.8, BOD- 7.14 and COD- 20.95 was observed . Bacterial load of water in term of MPN and SPC was found $11.6x10^2$/100 ml and $102x10^3$/ ml respectively. But a high degree of deterioration of water quality was recorded at Shyampur Khadir located about 1.5 Km. away from discharge point in down stream of the river Various parameters were found highly enhanced i.e. Hardness- 137.8, cholride- 14.3, BOD- 58.8, COD-162.45, MPN -$64x10^2$ and SPC- $290x\ 10^3$. Main cause of deterioration of water quality of Ganga at Shyampur Khadir was found due to the discharge of IDPL effluent which was highly polluted as evident by low level of DO-2.8 and high degree of BOD- 181, COD- 261.8 mg/l and MPN- $209x10^2$ and SPC- $380x\ 10^3$.

Introduction

Humans use water in the home, in industry, in agriculture and for recreation. These applications differ widely in quantity and quality of the water which they require.In general consumption of water per capita daily is more higher in urban areas than rural areas all over the world. Since last two decades regular demand of water has much enhanced due to over growth of population and rapid increase in urbanisation which had a direct effect on demand of water quantity in terms of liter/capita.

More food grains production is highly needed to fulfill nutritional requirement of the society and has forced to take up additional agricultural land for the purpose. Maximum consumption of water occurs in agriculture followed by domestic use and industry. Since a very little percentage of Fresh water, hardly 3% is available for civic use and out of which only 0.2% is in land water. The land surface water is a major source of civic supply in a large number of cities because these are located on the bank of the various rivers.

Inland surface water receives different kinds of pollutant from different sources in varying amount

which has a direct effect on water quality of that aquatic system in terms of various physico-chemical and bacteriological counts. Practice of indiscriminate discharge of untreated or partially treated municipal and industrial waste water has become a major cause of water pollution in India and abroad. Most of the rivers of country are being used for disposal of waste water (domestic and industrial sewage) as raw sewage/ or treated sewage. Since the maximum number of the cities including both Municipality corporation and Industries, either they do not posses treatment plant or they are not fit for a dequate treament or not in working condition, resulting pouring of raw sewage directly at different points in the several rivers and Ganga is one of them.

Ganga receives contaminants form of raw sewage at different places throughout its course. Rishikesh which seems an entry point of river Ganga in the plains, contains large number of drains carrying city sewage and industrial effluent and pouring it in the river at different points. Albeit a large number of industries are found in the Rishikesh region but Indian drug pharmaceutical limited (IDPL) is a major source of pollution of river Ganga. A lot of information is available regarding impact of drains on water quality of receiving system. Some important contribution in this area in the recent past can be mentioned (Shanker *et al.* 1986, Chopra & Rehman 1992, Chopra & Patric 2000, Prasad & Shankar 1999, Prasad *et al.* 2003 and Khanna and Chugh 2004). To find out intensity of pollution load of IDPL effluent and their impact on the water quality of Ganga at Shyampur Khadir, the present investigation was carried out.

Material and Methods

Haridwar is located in North India at foot hills of Shivalik hill range at altitude of 294.15 meter from sea level. The area has a tropical climate with seasons winter, summer and rains in a year. Following sampling points were selected to find out the real impact of IDPL effluent on water quality or river Ganga at Shyampur Khadir about 1.5 Km. in the down stream.

Sampling sites

1. Pashulok Barrage (up stream, without any out falls)
2. IDPL drain outfalls (carrying-IDPL effluent)
3. Shyampur Khadir (A point- showing impact of effluent on Ganga water after proper mixing dilutions)

Sample collection analysis

Water sample were collected from above mentioned sampling stations once in a month for estimation of various physical, Chemical and bacteriological parameters. Samples were collected

according to APHA (1985). DO was analysed at the spot by Winkler-idiometric method. Samples were collected in sterilized BOD bottles for bacteriological examination. These samples were brought to the laboratory and were analysed within 8 to 10 hours. Mac Conkey broth was used for estimation of most probable number(MPN) of total coliform bacteria and Nutrient agar media (NAM) for standard plate count of bacteria. pH of the medium was adjusted to 7.4 After inoculation and incubation at 35 ^{0}C MPN and SPC were recorded after 24 hrs. COD was estimated by autoclave method (1985). BOD was measured by seeding method. Chloride and sulphates were measured by titration method.

Results and Discussion

An average value of Physico-chemical and bacteriological characteristics studied for the period of three years at different sampling stations i.e. Pashulok Barrage, IDPL drain and Shyampur Khadir has been presented in the table. Water quality in terms of average value was found better at Pashulok Barrage 8.8mg/It but most polluted water was recorded in IDPL drain, where it (DO) was found very low 2.8 mg/It (Table). Similarly other parameters of organic contaminants i. e. BOD and COD were found very low at Pashulok Barrage 7.13 mg/l and 20.5 mg/l respectively, whereas these values were maximum recorded in IDPL effluent i.e. 181 mg/l and 261.8 mg/l. MPN and SPC were also found very low at Pashulok Barrage compared with IDPL drain. Low values of pollution indicator parameters at Pashulok Barrage were probably due to absence of any kind of discharge as well as minimum chances of soil erosion which contributes lot in raising of organic contaminates in the Ganga water. Besides this low temperature i.e. 17.96 has also played the significant role in minimizing the bacterial multiplication and lowering the consumption of dissolved oxygen by bacterial population.

Albeit enhanced value of BOD,COD,MPN, SPC and low level of DO in IDPL effluent, was directly related with organic contaminates but it seems that temperature has also played the role of a governing factor for all above parameters as it was found more about 7^{0}C from Pashulok Barrage. Higher temperature towards 30^{0}C facilitates for the multiplication of most genera and species of bacteria on one hand and also enhances the consumption of dissolved oxygen. Therefore a high level of reduction of dissolved oxygen occurs which is evident by the recorded date i. e. 8.8>2.80. Findings of different parameters related with organic pollution load of Shyampur Khadir indicated a high degree of deterioration of water quality at this sampling site compared with Pashulok Barrage. Since there was no any other discharge between IDPL factory and Shyampur Khadir except IDPL drain therefore it was only IDPL effluent which caused a serious loss of Ganges water in terms of water quality and it is evident by the recorded data at both sampling sites i.e. IDPL drain and Shyampur Khadir (Table-1).

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Table-1: Mean values of Physico-Chemical and bacteriological characteristics for the period of three years of IDPL effluent and their impact on water quality of river Ganges at Shyampur Khadir, Rishikesh.

Parameters	Sampling Stations		
	Pashulok Barrage	IDPL Drain	Shyampur Khadir
Temperature(^{O} C)	17.96	25.25	21.80
Turbidity(NTU)	7.00	95.00	7.00
pH	7.50	6.77	7.60
Conductivity(mmhos)	0.122	0.358	0.257
Hardness ($CaCO_3$) (mg/l)	103.43	191.00	137.80
Chloride(mg/l)	05.6	45.00	14.33
Sulphate (mg/l)	2.73	20.42	3.98
DO (mg/l)	8.80	2.80	5.33
BOD (mg/l)	7.13	181.00	58.80
COD (mg/l)	20.95	261.80	162.45
MPN (per 100ml)	$11.16X10^2$	$209.3X\ 10^3$	$64\ X\ 10^2$
SPC (per ml)	$102.6\ X\ 10^3$	$380\ X\ 10^3$	$290\ X\ 10^3$

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Limnological study of Sapna reservoirs at Betul (M.P.)

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Abstract

Preliminary limnological studies were conducted to find out quality of water in a permanent reservoir of Sapna Dist. Betul. Dissolved oxygen and pH of the water was normal while the alkalinity or the form of bicarbonate were quite high. Temperature fluctuation was between 30^{0}C to 13^{0}C Flora and fauna of the reservoir was quite rich.

Introduction

In Indian low line areas including temporary ponds, reservoir, and pools have been ecologically investigated by few workers. Unni (1983) studies the water chemistry in Chhindwara, Rao and Gupta (1986) studied the ecology of Gandhi sagar, Singhal (1985) studied the relationship among physical & chemical factor and plankton characteristics of ponds in Haryana. Ali(1993), cultured *Cyprinus carpio* in domestic waste water ponds. The present preliminary investigation was conducted to study the physico-chemical condition of Sapna Dam of Betul District (M.P.).

Material and Methods

The present study was conducted on Sapna Dam at Betul during July 2003 through December 2003.Sapna Dam is a water reservoir which fullfills, the requirements of surrounding 400 hectare Agricultural land on the other hand from where drinking water supply is also done. The water sample were collected during July 2003 through December 2003.Some of the physico chemical parameters like temperature, CO_2, pH, alkalinity, DO etc were studied..The water sample were collected at an interal of 12 Hrs. schedule. The physico-chemical and biological parameters were determined by following Standard methods of APHA 1998 and Mathur1982.

Results and Discussion

Dissolved (DO) Oxygen

Dissloved Oxygen shows fluctuation from 7.5 to 10.1 mg/l. The minimum dissolved oxygen was of 7.5 at the high temperature of 30^{0}C and increased according to the decreasing temperature.

Free CO_2

Free CO_2 content of the reservoir was nil at good favorable condition of Sapna, reservoir.

pH

The pH show very low fluctuation from 7 pH to 7.5 pH in the reservoir.

Alkalinity

The Alkalinity of the reservoir was found to be increased from 78 to 249 mg/l Decreasing temperature and the increasing density of the plants was the reason.

The Carbonate alkalinity increase from 7 to 17 mg/l and the low fluctuation is due to lack of phytoplankton population.

Temperature

The temperature show very high fluctuation from 30^0C (in July) to 13^0C (in December) the total fall of temperature is 17^0C.

Plankton

Plankton were found rich in the study pond.

Variation in phytoplankton population was noted that the phytoplankton were maximum in the evening time. Phytoplankton is directly correlated with free CO_2 the similar result were noted in the zooplankton population it means zooplankton avoids light. The dissolved oxygen was found minimum in the month of october it was due to the activity of plankton in the water. The pH of water is found alkaline during study period a positive correlation is found between pH and total plankton.

Acknoweledgement

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Table - 1: List of plankton available in the Reservoir of sapna Betul During July 2003 to Dec 2003

Plankton	Abundant	Common	Rare	Accidental
CHLOROPHYCEAE				
Chlamydomonas sp.	x			
Pandurina morum	x			
Eudorina elegans		x		
Chlorococoum sp.	x			
Chlorococum humicola			x	
Chlorella vulgaris	x			
Characium limenticum		x		
Pediastrum tetras				x
Tetradron tirgonum				x
Actinestrum hantzschil				
Coelastrum microporum			x	
Oocystis sp.				
Scendesmus quadricauda			x	
S. abundans		x		
S. alterans				x
Ankistrodesmus falcatus			x	
Cosmarium hammeri				x
C. Scabrum			x	
C. quinarium			x	
Clostenim sp.			x	
C. littorale				x
Uronema gigas			x	
EUGLENOPHYCEAE				
Euglena acus		x		
E. oxyuris			x	
E.sp.				x
E. tripteris				x
E. gracilis				x
E. munuta				
Phacus tortus			x	

Plankton	Abundant	Common	Rare	Accidental
P. Meson	x			
P. helikoides				x
P. longicauda			x	
P. acuminatus	x			
P. brachykentron			x	
P. orbicularis		x		
P. pyrum		x		
Trachelomonas varians			x	
T. similis		x		
T. armata			x	
T. superba			x	
T. hispida		x		
Lepocinclis acuta		x		
L. fusiformis				x
L. ovum			x	
L. textra				x
L. ovalis	x			
CYANOPHYCEAE				
Merismopedia glauca				x
Oscillatoria Princeps		x		
O. curviceps			x	
O. tenuis			x	
O. chalybea				x
Spirulina laxissima				x
Anabaena sp.	x			
BACILLARIPHYCEAE				
Navicula cuspidata		x		
Nitzchia palaea				x
Gomphonema sp.	x			
Frustulia sp.				x
PROTOZOA				
Amoeba proteus		x		
Arcella discoides	x			
A. valgaris		x		
Centropyxis aculeata				x
C. hemispherica		x		
Diffugia lebes		x		
Euglypha brachiata				x
E. mucronata				x
Euplotes S.P.				
ROTIFERA				
Brachinus Calyciflorus	x			
B. caudatus	x			

Plankton	Abundant	Common	Rare	Accidental
B. budapensis				x
B. falcatus		x		
B. forficula		x		
B. Patula				x
Platyas quadricornis				x
Lepadella ovalis	x			
L.rhomboides	x			
Lecana (monostyla) bulla			x	
Lecana curvicornis	x			
Filinia Longiseta		x		
F. opoliensis				x
Trichocera Sp.	x			
Synachaeta Sp.		x		
Haxarthra mira.				x
OSTRACODA				
Cypris sp.		x		
Stenocypris sp.	x			
CLADOCERA				
Moina brachiata	x	x		
Alona Sp.				
COPEPODA				
Mesocyclops sp.	x			

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Management of Greenhouse Gases for Environmental Prosperity: Literature Review and Introduction to IPCC

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Abstract

The topic of interest focus on understanding of components and source for Greenhouse Gas (GHG). It also says about the anthropogenic activities and natural process responsible for GHG generation. Emission inventories of natural and anthropogenic emissions are used by scientists as inputs to air quality models, by policy makers to develop strategies and policies or track progress of standards, and by facilities and regulatory agencies to establish compliance records with allowable emission rates. E-commerce, computer climate models and counter effect properties of sulfur dioxide has also changed the view about management of GHG. The discovery of new potent GHG, trifluoromethyl sulfur pentafluoride (SF_5CF_3) is considered the most potent GHG measured till date. The objectives, responsibilities and organizational behavior of intergovernmental Panel on Climate Change (IPCC) is of importance to the people involved in the GHG management and reporting of GHG emission inventories.

Key Words **:** ***Greenhouse Gases, Emission inventories, Global Warming Potential sink carbon storage, Ozone depleting substance, Sulfur dioxide, Criteria pollutants, Trifluoromethy sulphur pentafluoride, e-commerce, Computer climate model ,Intergovernmental Panel on Climate Change.***

Objective

This paper is the result of the effort from literature survey from various sources. The work was done in order to provide information to managers involved in greenhouse management. It provides a stepping stone for the new comers in the field of greenhouse gas studies and its management and to people who are concerned with Clean Development Policy. It also furnishes a basic information about the IPCC and its objectives. The paper also introduces some interesting topics of importance such as E-Commerce and greenhouse gases, Computer climate model and its credibility and soures, Potent new greenhouse gas(SF_5CF_3) and Counter effect properties of sulfur dioxide.

1.1 Introduction

J. Fourier first coined the term 'Green House Effect' in 1827. It is also called as 'Atmospheric Effect', Global Warming or 'Carbon dioxide problem. Several years ago, an atmospheric physics scientist, Dr. Gilbert Plass, warned that increase in CO_2 in atmosphere would have major impact in our climate (Sharma and Kaur, 1995). Later with industrialization, urbanization and with progressive development more gases accompanied CO_2. Some greenhouse gases occur naturally in the atmosphere, while others result from human activities. Naturally occuring greenhouse gases include water vapor, carbon dioxide, methane, nitrous oxide and ozone. Very powerful greenhouse gases that are not naturally occurring include hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6), which are generated in a variety of industrial processes.

Those, which cause adverse effects, are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and chlorofluoro carbons (CFCs). All these gas came to be called as 'Greenhouse Gas (GHG). The Green house effect may be defined as 'The progressive warming up of the earth's surface due to blanketing effect of anthropogenic gases in the atmosphere.

Each greenhouse gas differs in its ability to absorb heat in the atmosphere. HFCs and PFCs are the most heat-absorbent. Methane traps over 21 times more heat per molecule than carbon dioxide and nitrous oxide absorbs 270 times more heat per molecule than carbon dioxide.Often estimatesof greenhouse gas emissions are presented in units of millions of metric tons of carbon equivalents (MMTCE),which weights each gas by its GWP value or Global Warming Potential. Green House Effect (GHE) is essential for mankind and life. But man's activities are accelerating or enhancing the warming process to cause concern. All the green house gases are increasing at rapid rate. Increase in mean temperature created by green house effect would greatly affect man and other flora and fauna (Saji and Chacko 2001). Among the various emerging environmental issues UNEP(United Nations Environment Program) has identified global warming effect called, "green house effect" as most vexatious displeasing and disquieting. The control of greenhouse gas emission continues to be a major global problem.It is inter-disciplinary, both substance and approach and covers technical, political and economic issues involving governments, industry and the scientific community. The 1990s decade was the hottest decade of the last century and the warming is warmer than anything in the last 1,000 years.

The earth's atmosphere is warming faster than expected and evidence is mounting that human activity is responsible, the United Nations Environment Program has said. The UN's Intergovernmental Panel on Climate Change (IPCC) now projects the earth's average surface temperature will rise1.4 to 5.8 degree Celsius between 1990 and 2100 higher than its 1995 estimate of a one to 3.5

degree rise. There's no doubt the earth's climate is changing," IPCC chairman Robert Watson told a news conference in Shanghai on January 22, 2001.

Greenhouse Gas management for sustainable development is an overaching objective for human society that has emerged at the end of the twentieth century. The interaction between sustainable development and global climate change is especially important in view of the wide-ranging impact that the latter is likely to have (Catrinus and Munasinghe, 1998).

History of Green House Effect

CO_2 concentration was about 200 ppm only 20,000 years ago and corresponding temperature was 4^0 to 5^0 C lower than now. The value was 280 ppm about 10,000 years ago, 290 in 18 60, about 320 ppm in 1970 ,340-360 ppm in 1988 and is expected to be doubled by 2030 AD. The role of CO_2 can be visualized by comparing Earth with Mars and Venus. Venus has a large CO_2 content while Mars has very little. The net result is Venus is hot at 477^0 C, Mars is cold at-47^0C and the Earth has an average temperature of about 16^0C (Murali and Venkatarao, 1998).

1.2 Greenhouse Gas Impact on Environment

The decade of the 1990s was the hottest decade of the last century and the warming in this century is warmer than anything in the last 1,000 years in the Northern Hemisphere, IPCC chairman Roert Watson told a news conference in Shanghai on January 22, 2001. "We see changes in climate, we believe we humans are involved and we're projecting future climate changes much more significant over the next 100 years than last 100 years " he added.

Watson said the IPCC's latest report on climate change showed the main reason behind the faster than expected temperature rise was a fall in sulphur dioxide emissions. Green house gases such as carbon dioxide tend to warm the earth's atmosphere whereas sulphur dioxide tends to cool it.

More disease, less water. Watson said the implications of global warming on human health include increases in heat stress mortality in the summer and diseases such as malaria and dengue fever. It could also hit agriculture and water resources. Changing regional climate could alter forests, crop yields and water supplies. It could also threaten human health, and harm birds, fish, and many types of ecosystems. Deserts may expand into existing rangelands and the character of some of our National Parks may be permanently altered. Unfortunately many of the potentially most important impacts depend upon whether rainfall increases or decreases, which can not be reliably projected for specific areas.

Fluctuation in global temperature with increasing level of GHS is not expected to be uniform

entire globe. Recently in "World Climate Program "(WCP), it is estimated nearly 3 degree Celsius rise in temperature for doubling of atmoshpheric CO_2 and the probability of slight temperature change in the tropics, a 2 to 3 degree Celsius increase at mid latitudes and 8 to 10^0C in the polar regions. Actually air pollutants such as CH_4, N_2O, O_3, CFCs, CCl_3F posses intense infrared absorption, which could influence mean global temperature. The most adequate explanation is that the increase in CO_2 and aerosol content of the air has the potential to fluctuate the world's climate. According to UNEP, within next 25 years or so, there will be a rise in sea level by 1.5 to 3.5 meters (Sharma and Kaur 1995 and Bowen 1979).

1.3 Emission Inventories- Gases, Source and Sink

1.3.1 What are Emission Inventories?

An emission inventory is an accounting of the amount of air pollutants discharged into the atmoshpere. It is generally characterized by the following factors:

-the chemical or physical identity of the pollutants included,

-the geographic area covered,

-the institutional entites covered,

-the time period over which emissions are estimated, and

-the types of activities that cause emissions.

Emission inventories are developed for a variety of purposes. Inventories of natural and anthropogenic emissions are used by scientists as inputs to air quality models, by policy makers to develop strategies and policies or track progress of standards, and by facilities and regulatory agencies to establish compliance records with allowable emission rates. A wall-constructed inventory should include enough documentation and other data to allow readers to understand the underlying assumptions and to reconstruct the calculations for each of the estimates included.

The emission catergories prescribed by the IPCC 95 Guidelines for national greenhouse gas inventories have been considered.

1.3.2 Greenhouses Gases Categorization

A) Direct Greenhouse Gases: Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC) and perfluorocarbons (FC such as CF_4 and C_2F_6).

B) Indirect Greenhouse Gases: Nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC), carbon monooxide (CO), ozone (O_3), sulphur oxide (SO_x) and sulphur hexafluoride (SF_6).

1.3.3 Source of Greenhouse Gas Emissions

1.3.3 .1 Greenhouse Gas Emission (Based on Components)

1.3.3.1 a Carbon Dioxide Emission

Emission of carbon dioxide from coal and other combustion constitute a very significant contribution to total emission of GHGs from anthropogenic sources. In general, emissions of CO_2 are evaluated as the product of the quality of fuel sort and the corresponding emission factor for carbon dioxide (Pavel 1999). According to the standard IPCC methodology for GHG inventories (IPCC, 1997), Cabon Emission Factors (CEFs) are referred to the energy unit of each sort of fuel. The global carbon cycle is made up of large carbon flows and reservoirs. Hundreds of billions of tons of carbon in the form of CO_2 are absorbed by oceans and living biomass (sinks) and are emitted. See section 1.3.4 for more details.

1.3.3.1 b Methane Emissions

Atmospheric methane (CH_4) is an integral component of the greenhouse effect, second only to CO_2 as a contributor to anthropogenic GHS emissions. Methane's overall contribution to global warming is significant because it is estimated to be 21 times more effective at trapping heat in the atmosphere than CO_2 i.e., the GWP (Global Warming Potential) value of methane is 21. Over the last two centuries, methane's concentration in the atmosphere has more than doubled (IPCC 1996). Experts believe these atmospheric increases were due to largely increasing emissions from anthropogenic sources, such as landfills, natural gas and petroleum systems, agricultural activities, coal mining, stationary and mobile combustion, wastewater treatment and certain industrial processes atmoshpere annually through natural processes or sources. When in equilibrium carbon fluxes, among these various reservoirs are roughly balanced. Since the Industrial Revolution, the equilibrium of atmospheric carbon and methane has been altered (Cicerono and Oremland 1988, Sebacher *et al.* 1985, Sebacher *et al.* 1986).

Landfills

Landfills are the largest single anthropogenic source of methane emission. In an environment where the oxygen contents is low or nonexistent, organic materials, such as yard waste, household waste, food waste, and paper can be decomposed by bacteria, resulting in the generation of methane and biogenic CO_2. Methane emissions from landfillss are affected by site-specific factors such as waste composition, moisture and landfill size.

Natural Gas and Petroleum Systems

Methane is the major component of natural gas. During the production, processing, transmission and distribution of natural gas, fugitive emissions of methane often occur. Because natural gas is

often found in conjunction with petroleum deposits, leakage from petroleum system is also a source of emission. Emissions vary greatly from facility to facility and are largely a function of operation and maintenance procedures and equipment condition.

Petroleum is found in the same geological structures as natural gas, and the two are retrieved together. Methane is also saturated in crude oil, and volatilizes as the oil is exposed to the atmosphere at various point along the system. Methane emissions from the components of petroleum systems including crude oil production, crude oil refining and transportation.

Coal Mining

Produced millions of years ago during the formation of coal, methane trapped within coal seams and surrounding rock strata is released when the coal is mined. The quantity of methane released to the atmosphere during coal mining operations depends primarily upon the depth and type of the coal that is mined.

Methane from surface mines is emitted directly to the atmosphere as the rock strata overlying the coal seam are removed.Because methane in underground mines is explosive at concentrations of 5 to 15 percent in air, most active underground mines are required to vent this methane, typically to the atmosphere. At some mines ,methane-recovery system.

Other Sources

Methane is also produced from several other sources, including fuel combustion, wastewater treatmen, and some Industrial processes may supplement these ventilation systems and distribution generally occur as a result of system leaks, disruptions, and routine maintenance.

1.3.3.1c Nitrous Oxide Emissions

Nitrous oxide (N_2O) is a greenhouse gas that is produced both naturally, from a wide variety of biological sources in soil and water and anthropogenically by a variety of agricultural, energy related, industrial, and waste management activities (Anderson *et al. 1*986). While N_2O emissions are much lower than CO_2 emissions, N_2O is approximately 310 times more powerful than CO_2 at trapping heat in the atmosphere (IPCC 1996). During the past two centuries, atmospheric concentrations of N_2O have risen by approximately 13 percent.

As the emission inventories indicated (Second Report of the Govt. of Federal Republic of Germany on Environmental Policy of Climate Protection in Germany), there are three main sources of N_2O emissions.

* Industrial processes (adipic and nitric production).
* agriculture (animal husbandry, fertilizer use).
* combustion of fossil fuels.

Agricultural Soil Management

Nitrous oxide (N_2O) is produced naturally in soil through microbial processes of nitrification and denitrification. A number of anthropogenic activities add to the amount of nitrogen available to be emitted as N_2O by these microbial processes. Direct additions of nitrogen occur through the application of synthetic and organic fertilizers, cultivation of nitrogen-fixing crops, cultivation of high-organic-content soils,the application of livestock croplands and pasture, the incorporation of crop residues in soils, and direct excretion by animals onto soil. Indirect emissions result volatilization and subsequent atmospheric deposition of ammonia (NH_3) and oxides of nirogen (NO_x) and from leaching & surface run-off, Their indirect emissions originate from nitrogen applied to soils as fertilizer and from managed and unmanaged livestock waste. The biogenic soil emission of nitrous oxide is also prominent (Levin, 1989 and Levin, 1991).

Fuel Combustion

Nitrous oxide is a product of the reaction that occurs between nitrogen and oxygen during fuel combustion. Both mobile and stationary combustion emit N_2O and the volume emitted varies according to the type of fuel, technology, and pollution control device used, as well as maintenance and operating practices. For example catalytic converters installed to reduce highway vehicle pollution can result in the formation of N_2O.

Adipic Acid Production

The majority of the adipic acid produced in the United States is used to manufacture nylon6,6 Adipic acid is also used to produce some low temperature lubricants , and to add a "tangy" flavor to foods. Nitrous oxide is emitted as a by-product of the chemicalsynthesis of adipic acid.

Nitric acid Production

Nitric acid production is another industrial source of N_2O emissions. Used primarily to make synthetic commercial fertilizer, this raw material is also a major component in the production of adipic acid and explosives. Virtually all off the nitric acid manufactured in the United States is produced by the oxidation of ammonia, during which N_2O is formed and emitted to the atmosphere.

Manure management

Nitrous oxide is produced as part of microbial nitrification and denitrification processes in managed and unmanaged manure, the latter of which is addressed under agricultural soil management.

Other Source

Other sources of N_2O included agricultural residue burning, waste combustion and human sewage in wastewater treatment systems.

1.3.3.1b HFCs, PFCs & SF_6 Emissions

Substitution of Ozone Depleting Substances

Hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) are categories of synthetic chemicals that are being used as alternatives to the ozone depleting substances (ODSs). Because HFCs and PFCs do not directly deplete the stratospheric ozone layer, they are not controlled by the Montreal Protocol.

These compounds, however ,along with sulfur hexafluoride (SF_6),are potent greenhouse gases. In addition to having high global warming potentials ,SF_6 and many HFCs and PFCs have extremely long atmospher lifetimes, resulting in thier essentially irreversible accumulation in the atmosphere. Sulfur hexafluoride, itself, is the most potent greenhouse gas the IPCC has evaluated. The use and subsequent emissions of HFCs and PFCs as ODS substitutes increased in recent years. This increase was the result of efforts to phase-out CFCs and other ODSs especially the introduction of HFC-134a as a CFC substitute in refrigeration applications. This trend is expected to continue for many years, and will accelerate in the early part of the next century as HCFCs (Hydro chloro fluoro carbons) which are interim substitutes in many applications, are themselves phased-out under the provisions of the Copenhagen Amendments to the Montreal Protocol.

Other Industrial Sources

In addition to their use as substitutes for ozone depleting substances, the other emissive sources of these gases are aluminum production, HCFC-22 production, semiconductor manufacturing, electrical transmission and distribution, and magnesium production and processing. During the production of the primary aluminum, two PFCs (CF_4 and C_2F_6) are emitted as intermittent by-products of the smelting process. HFCs, PFCs, and SF_6 are also emitted from a number of other industrial processes.

1.3.3.1e Criteria Pollutant Emissions

In the United States carbon monoxide (CO), nitrogen oxides (NOx), nomethane volatile organic compounds (NMVOCs),and sulfur dioxide (SO_2) are commonly referred to as "criteria pollutants", as termed in the Clean Air Act. Criteria pollutants do not have a direct global warming effect,but indirectly affect terrestrial radiation absorption by influencing the formation and destruction of tropospheric and stratospheric ozone, or, in the case of SO_2, by affecting the absorptive characteristic of the atmosphere. Carbon monoxoide is produced when carbon-containing fuels are combusted incompletely. Nitrogen oxides (i.e. NO and NO_2) are created by lightining, fires, fossil fuel combustion and in the stratosphere from nitrous oxide (N_2O). NMVOCs which include such compounds as propane, butane and ethane are emitted primarily from transporta-

tion, industrial processes and non-industrial consumption of organic solvents. In the United States, SO_2 is primarily emitted from the combustion of fossil fuels and by the metals industry. In part because of their contribution to the formation of urban smog and acid rain in the case of SO_2 and NO_x. These gases also indirectly affect the global climate by reacting with other chemical compounds in the atmosphere to form compounds that are greenhouse gases. Unlike other criteria pollutants, SO_2 emitted into the atmosphere is believed to affect the earth's radiative budget negatively; therefore, it is discussed separately in section 1.9.

One of the most important indirect climate effects of criteria pollutants is their role as precursors for troposphere ozone formation. They can also alter the atmospheric lifetimes of other greenhouse gases. For example, CO interacts with the hydroxyl radical the major atmospheric sink for methane emission to from CO_2. Therefore, increased atmospheric concentrations of CO limit the number of hydroxyl molecules (OH) available to destory methane (Bowen, 1979).

Fuel combustion accounts for the majority of emissions of these gases (Crutzen and Andreae, 1990; Lobert *et al.* 1991). Industrial processes such as the manufacture of chemical and allied products metals processing and industrial uses of solvents are also significant sources of CO, NO_x, and NMVOs.

1.3.3.2 Greenhouse Gas Emission (Based on Anthropogenic Activities)

Sources of greenhouse gases are grouped under the following categories:

1.3.3.2a Energy-Related Emissions

1) Combustion Related

i) Energy and transportation industries

ii) Industry

iii) Transport (Road, Sea and Air)

iv) Residential, Commercial and Institutional (Not including transports in agriculture, silviculture and fisheries)

v) Other (military and including transports in agriculture, silviculture and fisheries)

vi) Combustion of Biomass

2) Production, Processing and Distribution of fuels

i) Solid Fuels

ii) Oil and Gas

3) Geothermal Energy

i) Geothermal Energy Production

1.3.3.2b Industrial Processes

i) Iron and Steel

ii) Non-Ferrous Metals

iii) Inorganic Chemicals

iv) Organic Chemicals

v) Non-Metallic Mineral Products

iv) Other

1.3.3.2c Solvent and Other Product Use

i) Paint

ii) Degreasing and Dry Cleaning

iii) Chemical Product Manufacturing/Processing

iv) Other

1.3.3.2d Agriculture

i) Fermentation

ii) Animal Waste

iii) Agriculture Soils

iv) Combustion of Agricultural Waste

v) Use of Chemicals in Agriculture

1.3.3.2e Land-use Changes and Forestry

i) Changes in Forests

ii) Conversion of Forest and Grassland

iii) Set-aside of Agricultural Land

iv) Abandonment of Managed Lands

v) Other

1.3.32f Waste Management

i) Landfills

ii) Waste Treatment

iii) Waste Incineration

Geothermal energy production increases the emission of geothermal steam and of the gases present there in. Emission from feed stocks is in the industrial process category of the inventory. For the production of iron and steel (ferrosilicon) the usage of carbon electrodes and coal have been considered feed stocks and accordingly included under the industrial processes category. For the production of aluminium the feed stocks are alumina, cryolite and carbon electrode which emissions handed similarly. The inventory includes for emissions of carbon dioxide, fluorocarbons

and sulphur oxides. For non-metal mineral production the main feed stocks causing emissions is the use of calcium carbonate from mollusc shell sand, in cement production.

1.3.4 Sink and Carbon Storage

What Are Sinks?

A sink is a reservoir that uptakes a chemical element or compound from another part of its cycle. For example, soil and trees tend to act as natural sinks for carbon-each year hundreds of billions of tons of carbon in the form of CO_2 are absorbed by oceans, soils, and trees. The major natural sinks are oceans and vegetation, they are also the sources. Carbon dioxide is absorbed and stored in vegetation as Organic Compounds.

Sequestration of CO_2

Storage of CO_2 in geological formations is attracting considerable attention nowadays. In order to find out more about the practical constraints on underground storage, the first of a series of studies on barriers to implementation of CO_2 capture and storage has examined storage in disused oil and gas fields. This study also provides up-dated estimates of the global storage capacity of depleted oil and gas fields including the potential for use of CO_2 for enhanced oil recovery. One of the options considered recently has been the conversion of CO_2 into a mineral carbonate,which offers the potential for very secure storage; this was reported in CO_2 storage as carbonate minerals. Various ideas have been proposed for storage as hydrates.

Another possible place for storing CO_2 would be in the deep ocean but this would be likely to raise many questions. The ocean is a natural sink for CO_2, taking up more than it releases to the atmosphere. Increasing the rate at which the ocean takes up CO_2 from the atmosphere, by artificial fertilization, could be used to increases the net take-up (i.e. the amount stored).Having reviewed this option previously, one of the outstanding questions about macronutrient fertilization has now been examined through a modeling study-Enhancement of oceanic uptake of CO_2 by macronutrient fertilization.

Increasing the terrestrial sink is an analogous option on land. This could be done, for example ,by increased afforestation. Even though urban forestry and greenbelt have common objective of reducing atmospheric air pollutant load among them some are GHG, but their definition and mode of achieving this objective are widely different. A fast growing tree absorbs upto 22 kilograms of Carbon-dioxide per year, that is about 10 tons per acre of tree enough to offset the Carbon dioxide produced by driving a car 34,000 km. (Saji, 1998).

The role of vegetation in mitigating the excess of Carbon dioxide and the warmth of the atmosphere has been appreciated since long as they can store large amounts of carbon. Vegetation may be able to moderate or postpone built up of atmospheric carbon and thereby delay the process of

global warming. The expert on the science of global warming thinks that it is possible to expand the existing carbon sink or create new ones. Such carbon sink could sequester the excess 2.9 billion tons of free carbon dioxide (Shukla, 1983).

John Martin of United States has floated suggestion that a few hundred thousand tons of iron (Fe) be dumped into the ocean around Antarctica, which would rise the species of phytoplankton in water. They grow like crazy and draw CO_2 out of the atmosphere, thus cooling down an over heating planet. Martin's idea has raised quite a few eyebrows, but with raising temperature one can hardly effort to take any chances. Martin measured the concentration of several trace metals in seawater, among them Fe too. He observed that the poor growth of phytoplankton on the water aound Antarctica is due to an acute deficiency of Fe.

1.4. Potent New Greenhouse Gas

A report from MAINZ, Germany, July 31, 2000 (ENS)- Researchers from seven institutions in Germany, the United Kingdom and the United States have detected a previously unreported compound of industrial origin in the atmosphere- trifluoromethyl sulfur pentafluoride (SF_5CF_3). It is considered the most potent Greenhouse Gas measured to date.

The new greenhouse gas was discovered by scientists at the Max Planck Institute for Chemistry in Mainz, Germany, working with researchers from the School of Environmental Science at University of East Anglia in the UK, Ford Motor Company, USA, University of Reading,UK; Natural Environment Research Council in Cambridge, UK; and the University of Frankfurt working with scientists from the British Antarctic Survey.

There is no doubt that the new gas SF_5CF_3 is made by industry or is produced during certain processes involving industrial gases, but its exact source remains a mystery. Analysis of Antarctic snow revealed a new greenhouse gas, SF_5CF_3. The increase of this peculiar gas in the atmosphere is coupled with the increase of the very inert gas sulfur hexafluoride (SF_6), suggesting a common source, according to their article in the journal "Science", a publication of the American Association for the Advancement of Science. Emissions of sulfur hexafluoride (SF_6) are governed by the Kyoto Protocol,an addittion to the United Nations Climate change treaty. It is one of the six greenhouse gases linked to global warming.

The scientists speculate that SF_5CF_3, which is closely chemically related to SF_6 ,originates as a breakdown product of SF_6 in high voltage equipment. SF_6 is used in electrical switches to suppress sparks, in protecting metals during a melting process, in tennis balls, car tires and even at one stage in running shoes. Due to its good insulation properties it was also used as a noise barrier in double glazed windowpanes.

SF_5CF_3 is a breakdown product of the gas SF_6 in high voltage equipment. SF_6 is used to electrically insulate high voltage components. SF_6 is a strong greenhouse gas and the molecule is very resistant against attack in the atmosphere. The natural self-cleansing property of the atmosphere is insufficient to deal with such super molecules. It has a long lifetime, and being a strong greenhouse gas, its production is now restricted under the Kyoto Protocol.

The new molecule SF_5CF_3 is even a stronger greenhouse gas. Measurements of its infrared absorption cross section revealed the largest radiative forcing, on a per molecule basis, of any gas found in the atmosphere to date, the discoverers report. It has a long lifetime- somewhere between several hundred and a few thousand years.

The researchers found this new gas while conducting expeditions in Antarctica to extract air samples from the thick firm layers of snow. These layers up to 100 meters thick, contain old air, sometimes from the beginning of the last century, according to Carl Brennikmeijer of the Max Planck Institute.

" This air has been extensively analyzed in our institute and in Norwich, England. The new gas was discovered at extremely low concentrations" he said. "Without even knowing it, we have been releasing a very potent greenhouse gas for almost 50 years. We have to find the source of this gas and to try to stop its increase," Brenninkmeijer said.

1.5 Greenhouse Gas Emission-Trends in Energy Production and Consumption

Current pattern in production, development and consumption around the globe pose serious threat to global ecosystem. In all the process energy is consumed, produced and transformed in any form. Carbon fuel is the major source of energy. In the transaction, liberation of pollutants is a common phenomenon. GHG is a part of it. Economy of nation is the measure of the energy status. The pattern of utlilization and involvement of energy in development judges its contribution towards GHG account.

Curbing the GHG depends upon the correlation between economy, energy and technical advancement. But some where the policies, management or system process has to compromise with the factors or component in the technical development system as whole for sustained GHG control and checking. Reviews by Capoor *et al.* (1996) and Reid and Goldemberg (1997) have cited significant steps that are being taken by developing countries to reduce rates of growth in carbon emissions.It is seen that since the United Nations Framework conventions on Climate Change (UNFCCC) ,carbon emission savings in development countries are very much prominent than industrialized countries (Reid and Goldemberg, 1997).

Energy use for various services has a number of impacts on the environment. Energy combustion by-products include SO_x, NO_x and precursors of ground-level ozone. Another combustion by-product is CO (carbon dioxide). CO_2 a greenhouse gas, has been identified as a potential major contributor to global climate change (Hao *et al.* 1990).

Clean energy technologies may be one of the most effective responses to reducing greenhouse gas emissions.

1.5.1 The Carbon Emissions from Energy Use Depend on a Number of Factors

The level of demand for energy services,

The service energy intensity (energy requirement per unit of service).

The mix of energy sources for the service,

The carbon content of the energy sources,

Electricity and other energy is derived from other forms of energy. For these sources, the mix of fuels may be used in their production, which is an additional factor in carbon emissions. Energy efficiency affects the service energy intensity. If energy were used more efficiently, the energy intensity would decrease, as would the carbon emissions, while maintaining the same level of service.

1.5.2 General Trends in Carbon Emission in Industries (Data related to US)

The statistical data varies from underdeveloped to developed through developing nations based on infrastructure, technologies, available resources and process.

(i)Carbon Emission in Manufacturing Industries

Manufacturing, which accounts for about 80 percent of industrial energy consumption, also accounts for about 80 percent of industrial energy-related carbon emissions. (Agriculture, mining forestry, and fisheries account for the remaining 20 percent). Three industries, petroleum chemicals, and the primary metals emitted almost 60 percent of the energy-related carbon in manufacturing. The next three largest emitters (paper, food, and the stone, glass and clay products industry) produced an additional 22 percent of the energy-related manufacturing emissions.

The carbon intensity of energy use is the amount of carbon emitted per unit of energy used. Both the mix of energy sources used and uses of energy affect carbon intensity. For electricity that manufacturers purchase, the carbon emissions occur where the electricity is generated, rather than at the manufatcturing establishment. These emissions are assigned here to the ultimate user. The metals industry has a relativey high carbon intensity, due to the extensive use of coal (primarily in the iron and steel industry) and electricity (in the aluminium and iron and steel

industries). In contrast, the paper industry has relatively low carbon intensity, due to its use of renewable energy sources. The two industries with the highest carbon emissions, the petroleum refining and chemicals industries, have relatively low carbon intensities. These industries use large amounts of energy, but do not use all of that energy as fuel.Instead, these industries convert energy sources, such as liquefied petroleum gases or natural gas, into other products. A portion of the carbon contained in the original energy source is sequestered in the product rather than emitted to the atmosphere.

(ii) Carbon Emissions in the Coal and Petroleum refining Industry

Petroleum refining is by far the largest component of the petroleum and coal products industry. The petroleum refining industry uses almost 30 percent of all energy used in manufacturing and emits over 20 percent of the carbon. Only about half of the energy is used as fuel; the rest is used as feedstock. Over half of petroleum refining carbon emissions is from petroleum by products (chiefly still gas and petroleum coke) used as fuel. A significant amount of carbon is sequesterd in petrochemical feedstock, resulting in a relatively low overall carbon intensity.

(iii) Carbon Emissions in the Chemical industry

The chemical industries as a whole uses almost 25 percent of manufacturing energy and emits over 20 percent of the carbon. The plastics industry alone emits over 2 percent of all natural gas and electricity are two largest sources of energy-related carbon emissions for the chemical industry. A significant amount of the carban content of the energy is sequestered in chemical industry products, such as plastics and fertilizers, rather than emitted through combustion.

(iv) Carbon Emissions in the Iron and Steel Industry

Besides steel mills and blast furnaces, the primary metals industry also includes the aluminium industry, copper industry, and other metal industries, Within this group the iron and steel industry emits our 60 percent of the energy related carbon.

Coal accounts for almost 60 percent of the energy-related carbon emissions in the iron and steel industry. Electricity and natural gas use, emits an additional 35 percent of the energy-related carbon. Almost all of the coal is converted to coke for the manufacture of steel, rather than used directly as a source of fuel.

(v) Carbon Emissions in the Paper Industry

Paper and paperboard mills emit over 80 percent of the energy-related carbon in the paper industry. Electricity, natural gas and coal account for most of the energy-related carbon emissions in the paper industry. Nearly half of the energy used in the paper industry is renewable, consisting of wood and paper byproducts (pulping liquor, wood chips, and bark). Renewable energy

sources are not considered net emitters of carbon.

(iv) Carbon Emissions in the Food Industry

The food industry group encompasses a wide variety of industries. The wet corn milling industry emits almost a sixth of the energy-related carbon in the food industry. Two sources, natural gas and electricity , each account for roughly 40 percent of the energy-related carbon emissions in the food industry. About one-sixth of the emissions come from the use of coal.

(vii) Carbon Emissions in the Stone, Clay and Glass Industry

The cement and lime manufacturing industries emit almost half of the energy-related carbon in the stone, clay, and glass group of industries. The cement and lime industries also emit a significant amount non-energy-related carbon. Three sources coal, natural gas, and electricity account for 91 percent of the energy-related carbon emissions in the stone, clay, and glass industries.

1.6 E- Commerce and greenhouse gas

E-Commerce will have far-reaching social and environmental impacts, from changes in the use of raw material and energy to new settlement and transportation patterns that affect our communities (Saji and Chacko, 2001).

Sustainable development has increasingly become a critical issue facing both developing and developed countries. In addition to global warming and environment deterioration, the emerging information-based economy has raised attention of policy-makers in almost all countries. No country can afford to lose this new round of competition. There are many factors that are critical, to the success of the new economy. To guarantee the sustainable development of the information infrastructure and henceforth the sustainable development of the society and economy, appropriate policy and strategy are therefore extremely critical.

"It's unlikely e-commerce will save the planet as some have claimed", says Bette Fishbein, a senior fellow at Inform, an environmental research organization in New York City. "There might be some reductions in energy use, but there's a huge increase in packaging and shipping by air results in much more air pollution. Office paper use has doubled since the wide-spread use of computers so much for promise of the paperless office." But on other hand "Joseph Romm, executive director of the Center for Energy and Climate Solutions and an expert in energy use" says. "The economy is growing rapidly, but energy demand is much lower since the advent of the Internet and thus reducing the greenhouse emission."

There is a debate over electricity and the Internet. We're using a fair amount of electricity to keep the Internet economy hot. Internet use could eventually have an important impact on energy consumption and greenhouse gas emissions. The Internet also generates energy gains through ematerializations. E-materialization of paper, construction, and other activities could produce

greenhouse gas savings. The statistics from some publication reports-greenhouse gas savings for avoiding the use of a ton of paper is estimated at 3.3 metric tons of carbon dioxide equivalent of newspapers and 3.8 for office paper. Despite increased use of office paper, use of the Internet could save 2.7 million tons of paper annually by 2003. The resulting cut in global warming pollution will equal some 10 million tons of carbon dioxide. Both figures could double by 2008.

A minute spent driving to a store uses more than 10 times the energy of a minute spent shopping on-line. On-line shopping avoids car trips and reduces congestion, and mobile emissions (Saji and Chacko 2001). Nearly 40 percent of people with Internet access say they go to stores less often. It seems clear that the "new energy economy" will profound impacts on energy, environment and economic forecasting. The e-commerce impact on energy use, however, should not be viewed as a panacea.

Confusion still persists in the contribution of e-commerce towards green environment and the debate is still continuing. Whole computer industries right from the use and process of raw materials for the production of computers, its accessories, operation and application results need to be accessed with reliable attitude. Is e-commerce a friend or foe of the environment?

1.7 Greenhouse Gas Dynamics (GGD) Studies

Greenhouse Gas Dynamics (GGD) includes research and studies on the complex chemical processes both natural and industrial, which lead to GHG production and release and on the interactions of greenhouse gases with light, other atmoshperic gases, surfaces, and other relevant substances. Research focused on laboratory investigation of processes at the molecular level, development of experimental data necessary for effective modeling and prediction of greenhouse gas effects on a global scale, and identification of alternative, less environmentally destructive substances.

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Photochemical studies of greenhouse gases, undertaken because of environmental relevance, have revealed much about the reaction chemistry of isolated gases. The complex nonlinear interactions of multiple gases and phases, however are only vaguely understood despite their clear climatic importance. Photochemical studies aimed at improving understanding of the behavior of complex systems are encouraged.

Only recently has it been appreciated that a combination of mass and thermal transport, photochemistry and surface chemistry is necessary to desribe interactions of GHGs in the atmosphere. This progress supports investigations of adsorption, photochemistry and bulk reactions between GHGs and other substances frequently at surfaces or in aerosols or hydrosols which

deterrmine their environmental impact on global climate change. Surface interaction studies that point to new and effective means for selectively removing GHGs from process streams or catalyzing their conversion to innocuous substances are also appropriate.

Proposals for development of new physical and chemical tools to carry out analysis essential for characterization of environmentally critical interactions to be considered (National Academic of Sciences, 1984). Attention will be given to developing reliable techniques for in situ sensing and quantification of GHGs and understanding fundamental chemistries underlying passive and active sensor design.

1.8 Computer Climate Model and Its Credibility

Even when measured against the suspect data gathered from surface thermometers in towns and cities, the warming is still well below that which models say should have happened by now. When compared with the more accurate and global satellite temperature series since 1979, the gap between theory and reality is even wider.

According to Tom Wigley, chief scientist of the National Center for Atmospheric Research, Boulder, Colorado, USA why global warming has fallen so far short of what computer models say should be happening by now?

Reasons or Excuse

In a paper published, not in a scientific journal, but by the rich environmentalist Pew Center on Global Climate Change', titled "The Science of Climate Change: Global and U.S. Perspectives," Tom Wigley repeats, by now, lame excuse to explain away the lack of warming so far.

The critical issue is Sulfur Dioxide (SO_2), a common byproduct of fossil fuel burning in older combustion systems. These 'sulfates' are blamed for acid rain and newer combustion systems extract sulfates before they escape to the atmosphere. As the newer technology spreads in usage, sulfate levels in the atmosphere can be expected to fall.

Several years ago the Greenhouse Industry seized on a theory floated by prominent US green-house skeptic Prof. Patrick Michaels, namely that the presence of sulfates in cloud formations made them brighter to sunlight. Brighter clouds would make them more reflective, thus tending to cool the earth, partially countering the warming effect alleged from carbon dioxide (CO_2).

While Michaels originated this hypothesis, he was also very prompt in discarding the theory when it was clear that observational evidence did not support it-as any good scientist would. But good scientists do not inhabit the Greenhouse Industry. They saw in Michaels' sulfate theory the excuse they needed for the lack of significant warming to date. Rather than pay heed to the mounting physical evidence that the sulfates theory was a non-starter, they instead incorporated

the theory into the climate models, making it a dogma of faith among environmentalists and even the Intergovernmental Panel on Climate Change (IPCC).

But Wigley has given the sulfates theory an added twist in his latest paper. Having claimed that sulfates have been applying a cooling brake to global warming, he then went on to claim that global warming would accelerate even faster than expected once the sulfate emissions were wound back. If we save the world from acid rain, we might exacerbate the global warming problem.

1.9 Sources and Counter Effect Properties of Sulfur Dioxide.

Sulfur dioxide (SO_2)emitted into the atmosphere through natural and anthropogenic processes affects the earth's radiative budget through its photochemical transformation into sulfate aerosols that can

(i) Scatter sunlight back to space, thereby reducing the radiation reach i n g the Earth's surface;

(ii) Affect cloud formation; and

(iii) Atmospheric chemical composition (e.g., Stratospheric ozone, by pro viding surfaces for heterogencous chemical reactions).

The overall effect of SO_2 derived aerosols on radiative forcing is believed to be negative (IPCC 1996). However, because SO_2 is short-lived and unevenly distributed in the atmosphere, its radiative forcing impacts are highly uncertain.

Sulfur dioxide is also a major contributor to the formation of urban smog, which can cause significant increases in acute and chronic respiratory diseases. Once SO_2 is emitted, it is chemically transformed in the atmosphere and returns to the Earth as the primary source of acid rain. Electric utilities are the source of SO_2 emissions. Coal conbustion contributes nearly all of those emissions. Sulfur dioxide emissions have decreased in recent years, primarily as a result of electric utilities switching from high sulfur to low sulfur coal.

1.10 The Intergovernmental Panel on Climate Change (IPCC) *What's the Intergovernmental Panel on Climate Change?*

Is the premier organization for National Greenhouse Gas (GHG) Inventories and Programs. The World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP) established the Intergovernmental Panel on Climate Change (IPCC) in 1988. Its main objective was to assess scientific, technical and socio- economic information relevant to the understanding of human induced climate change, potential impacts of climate change and options for mitigation and adaptation. The IPCC brings together the world's top scientists in all relevant fields,

synthesizes peer-reviewed scientific literature on global warming studies, and produces authoritative assessments of the current state of knowledge of climate change. The IPCC has completed two assessment reports, developed methodology guidelines for national greenhouse gas inventories, special reports and technical papers.

About National Greenhouse Gas Inventories Program

A national greenhouse gas inventory is a record of the emissions by sources and uptake by sinks of greenhouse gases and their precursors that arise from human activities in a country over a year. Nations have committed themselves to producing such inventories annually under the United Nations Framework Convention on Climate Change.

The IPCC has Three Working Groups and a Task Force

Working Group I (WGI): The science of climate change

Working Group II (WG II): Impacts, adaptation and vulnerability

Working Group III (WG III): Mitigation of climate change and

Task Force on National Greenhouse Gas Inventories (TFI)

The TFI was established by the IPCC, at its 14th session (October 1998), to oversee the IPCC National Greenhouse Gas Inventories program (IPCC-NGGIP). This program had been undertaken since 1991 by the IPCC WG I in close collaboration with the Organization for Economic Co-operation and Development (OECD) and the International Energy Agency (IEA). In 1999, The Technical Support Unit (TSU) set up at the Institute for Global Environmental Strategies (IGES) in Japan took over this program in accordance with a decision taken by the IPCC at its 14 th session. The Objectives of the IPCC-NGGIP are to develop and refine an internationally-agreed methodology and software for the calculation and reporting of national GHG emissions and removals, and to encourage the widespread use of this methodology by countries participating in the IPCC and by signatories of the United Nations Framework Convention on Climate Change (UNFCCC).

Working Group I : The Science of Climate Change

Shanghai, 20 January 2001, IPCC Working Group I accept its contribution to the IPCC Third Assessment Report " Climate Change 2001 : The Scientific Basis" (Nertpura) Geneva, 16 February 2001, IPCC working group II accepts its contribution to the IPCC third assessment report "Climate change 2001. Impacts, Adaptation and Vulnerability".

The responsibility of Working Group I (WGI) is to assess available information on the science of climate change, in particular that arising from human activities. In performing it assessments WGI is concerned with :

Developments in the scientific understanding of past and present climate, of climate variability, of climate predictability and of climate change including feedback from climate impacts Progress in the modeling and projection of global and regional climate and sea level change Observations of climate, including past climates, and assessment of trends and anomalies; gaps and uncertainties in current knowledge.

Working Group I is guided by a Bureau, which is co-chaired by Sir John Houghton (UK) and Prof. Ding Yihui (China). Working Group I also has a Technical Support Unit (TSU) to help direct the production of reports. The TSU is housed in the Hadley Centre, which is part of the United Kingdom's Met. Office.

Working Group II: Impacts, Adaptation and Vulnerability

IPCC Working Group II accepts its contribution to IPCC Third Assessment Report:

"Climate Change 2001 : Impacts, Adaptation, and Vulnerability"

In its reports, Working Group II assesses the scientific, technical, environmental, economic and social aspects of the vulnerability (sensitivity and adaptability) to climate change of, and the negative and positive consequences for, ecological systems, socio-economic sectors and human health, with an emphasis on regional sectoral and cross-sectoral issues. Working Group II is guided by a Bureau, which is chaired by Osvaldo Canziani (Argentina) and James McCarthy (USA). Working Group II also has a Technical Support Unit (TSU) to help direct the production of reports. The TSU is housed in Washington DC.

Working Group III : Mitigation of Climate Change

The Scientific Basis : IPCC Working Group I Third Assessment Report accepted in Shanghai, 20 January 2001. Impacts, Adaptation and Vulnerability : IPCC Working Group II Third Assessment Report accepted in Geneva, 16 February 2001.

As part of the IPCC, Working Group III is charged to assess available information on the science of climate change, in particular that arising from human activities. In performing its assessments the WGIII is concerned with the scientific, technical, environmental, and economic and social aspects of mitigation of climate change. After the successful completion of the first and second IPCC assessment report on climate change in 1990 and 1995 respectively, WGIII is now in the process to work on the third assessment report (TAR) through the assessment process, WGII is also involved in preparation of special reports, technical papers, and guidance papers on cross-cutting issues and other related activities. Two IPCC Special Reports were prepared by Working Group III on Mitigation of Climate Change :

(i) Methodological and Technological Issues in Technology Transfer and

(ii) Emission Scenarios

Task Force on National Greenhouse Gas Inventories

The Task Force on National Greenhouse Gas Inventories (TFI) has a Bureau with 15 members including its two Co-chairs, and a Technical Support Unit.

Task Force Bureau (TFB)

The TFB shall provide guidance to the IPCC-NGGIP and develop it as required. The TFB consists of 15 members confirmed by the IPCC Bureau in February 1999.

Technical Support Unit

IPCC-NGGIP

The inauguration of the TSU took place on Saturday 25 September 1999 in Tokyo, Japan. Seven staff members, including four who have been internationally recruited, are now working.

The Technical Support Unit (TSU) for IPCC-NGGIP is based at the Institute for Global Environmental Strategies (IGES) in Japan. The Unit is funded by the Government of Japan. The TSU is responsible to the Task Force Bureau (TFB) which shall provide guidance to the IPCC-NGGIP and develop it as required. The TSU shall assist the Co-chairs and serve the needs of the IPCC-NGGIP. The establishment of TSU at IGES was completed in September 1999 with very substantive co-operation from the IPCC, OECD, IEA, Government of Japan and other related institutions. Seven staff members, including four, who have been internationally recruited, are now working in the TSU at IGES.

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Accumulation of heavy metals in crop plants through irrigation of contaminated ground water in Panipat region.

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Abstract

In the modern industrialization period, most of water resources had affected enormously by seepage, leaching and intermixing of industrial effluents. The textile effluents had consisting high concentrations of trace heavy metals and through its accumulations in different trophic levels of ecosystem ultimately cause the health hazards among livestock and human beings. The different crop plant samples collected from agriculture fields adjoining of textile industrial effluent flowing channels contained in situ these heavy metals e.g. Lead (pb), Copper (Cu), Manganese (Mn), Nickel (Ni), Iron (Fe), Cadmium (Cd) and Zinc (Zn). The bioremediation processes are urgently required to combat ground water pollution.

Key words-: Heavy metals, Textile effluents, Bio-accumulation, Industrial pollution, Crop plants.

Introduction

In India, the industrial effluents have contributed as major source of pollution. Different industries of the country contribute about 16% of the total waste water generated. The treatment facilities have been installed in less than one third of the polluting industries (Gopal, 1994). Most of effluent treatment plants (ETP) have not performed physical and chemical treatment processes satisfactory due to economic reason on commercial scales.

Textile industrial effluents have accounted to about 15-20% of total waste water in the country. The textile effluents containing different colours, inorganic and organic chemicals and heavy metals are highly polluted in nature and vary in its composition. The practice of disposing textile wastewater without any treatment affects the aquatic and soil system. In the adjoining agricultural area of textile industries sector, there is immense potential of ground water being contaminated from effluents.

The present study reveals the accumulation of different heavy metals in crop plants and exhibits the cycles of transfer of heavy metals from industrial effluent to consumer levels and lastly affected the health of livestock and human being.

Materials and Methods

Panipat is situated on the national highway of Delhi-Chandigarh in Haryana, which is well known for textile and dye industries. The effluent samples were collected from the outlet of dyeing units and analyzed the physico-chemical parameters (APHA, 1995). Shoot and root samples of different crop plants grow in agriculture fields were also collected for analysis. These samples were washed with tap water, dilute hydrochloric acid, and distilled water and then dried in oven at 67^0C and grind in a stainless steel grinder to pass through 16-mesh sieve. Plant samples were digested in HNO_{3-} $HCIO_4$ diacid mixture and analyzed by atomic absorption spectrophotometer AAS-4129.

Results and discussion

The textile effluent had alkaline pH varied 7.3-8.25. Dissolved oxygen of the dye house waste water was higher in comparison to the sewage water. The impact of dissolved oxygen was also quite obvious on BOD (Biochemical oxygen demand). The COD (Chemical oxygen demand) of the dye waste water was very high being (137 - 734 mg/I). Senthinathan and Azeez (1999) and Groff (1993) reported that textile waste waters may cause problem used as untreated effluent consists higher phosphorous, COD, pH, temperature and absorbable organic halogen. Since NaCI is mostly used for fixing dyes the contents of both CI and Na increased with electrical conductivity.

Concentration of heavy metals in textile effluents as Zn, Ni, Mn and Cd were observed quite low while the Fe, Cu and Pb were analyzed to be slightly higher (table-1). Rahman (1996), Usha (1989) and Khan *et al.* (1995) also found Pb and Cd in excessive amount than those of the permissible limits.

The chemical analysis of the crop plants from the adjoining agricultural fields, which are mostly irrigated by ground water through bore tube well in Panipat region were found to accumulate the heavy metals like Pb, Cd, Fe, Mn, Ni, and Cu contents were with in the prescribed limits excepts lead (Pb). The concentration of Pb in Barseem and Cauliflower shoots was recorded 18 ppm and 24 ppm respectiviely. Moreover Pb contents in roots of crop plants were still higher varied as 16 - 28 ppm(Table-2). It has been earlier reported, by Khan *et al.* (1997) and Navarro (1993) that use of textile industrial wastewater in irrigation, increased heavy metals contents in the crop plants.

The contents of lead are beyond safe limits and hence its sources need to identified and remediated otherwise it would create health hazards. The effluents also cause various health problems such as skin allergies, lung infection, carcino-mutagenic disorders among the human being through contaminated ground water supply by municipal tube well water scheme (Kumar 1998 and Sharma *et al.* 1999).

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Table 1: Physico-chemical parameters and heavy metals of textile effluents.

Parameters	Effluent-I	Effluent-II	Effluent-III	Effluent-IV
EC (ms/m)	5.87	1.50	7.70	4.45
TDS(gm/l)	2.93	7.38	4.09	7.28
pH	7.30	8.00	7.50	8.25
DO (mg/l)	7.70	5.20	1.80	1.30
BOD (mg/l)	31	51	27	51
COD (mg/l)	734	158	137	151
Na (mg/l)	9.90	1.84	3.04	5.27
K (mg/l)	0.36	0.43	0.22	0.53
Ca+Mg (mg/l)	11.20	7.60	5.60	9.00
Cl (mg/l)	2.20	3.20	3.00	6.10
CO_3 (mg/l)	1.20	0.00	0.00	0.00
HCO_3 (mg/l)	11.60	6.50	3.95	4.60
PO_4 (ppm)	4.0	0.0	0.0	1.0
NH_3 - N (ppm)	60.90	2.45	2.15	3.50
NO_3 - N (ppm)	3.50	8.40	8.20	2.45
Mn (ppm)	0.06	0.01	0.16	0.069
Ni (ppm)	0.02	0.00	0.05	0.00
Fe (ppm)	0.30	0.03	0.12	0.12
Cu (ppm)	0.13	0.02	0.10	0.40
Cd (ppm)	0.00	0.01	0.02	0.01
Pb (ppm)	0.23	0.18	0.59	0.33
Zn (ppm)	0.20	0.03	0.03	0.11

Table 2: Heavy metals in crop plants samples.

Crop plants	Pb (µg/g)	Cd (µg/g)	Fe (µg/g)	Zn ((µg/g)	Mn (µg/g)	Ni (µg/g)	Cu (µg/g)
Shoots							
Wheat shoot	10	0.20	144	271	16	15.6	4.0
Barseem shoot	18	0.6	172	264	10	23.2	7.2
Radish shoot	0.0	0.0	126	249	21.4	18.8	0.4
Cauliflower shoot	24	0.0	215	284	23.0	0.0	10.3
Coriender shoot	0.0	0.0	107	266	36.0	15.6	2.8
Roots:							
Barseem root	27	0.0	165	220	57.6	30.2	8.3
Radish root	16	0.0	146	136	42.2	0.0	10.4
Cauliflower root	28	0.0	196	156	45.2	0.0	16.2
Coriender root	22	0.0	179	152	36.2	0.0	6.2
Palak root	21	0.0	172	122	35	0.0	12.0

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